THE

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1901 Edition

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STORAGE BATTERIES IN ELECTRIC POWER STATIONS.

MR. HIGHFIELD'S excellent paper of May 9th, read before the Institution of Electrical Engineers, is another valuable contribution to the arguments for the accumulator. Everything now turns on the ability of manufacturers to supply suitable accumulators and upon the ability of station engineers to give them proper attention. No doubt much harm has been done to the accumulator interest by bad usage of their products. As Mr. Highfield puts it, a battery is installed; it proves very useful; the load in the station grows, and the battery is called upon to do more than the duty it was intended for. It falls into disrepair and is disused, and another bad name is given to the battery. Additions to plant often leave the battery out of the family, and small wonder that it breaks down.

Mr. Highfield has rejected the regulating cell system, and now regulates by the variable pressure booster, so designed that by varying the field the pressure can be varied from 0 to a maximum either way. He uses a double-wound armature in one field, each half of the battery being in series with one of the armature windings, and the field is varied by a 30-point rheostat and a reversing switch so interlocked with it as to vary the volts given by each armature from 0 to 50, each point serving to vary through two volts. The battery centre is connected to the neutral bus bar of a three-wire system, and a good type of balancer is employed. One-half of the battery may be charged by disconnecting the other half entirely from the bus bars and charging through the balancer. The battery serves (1) as a controller for station pressure; (2) as a store to allow the generators to be run at constant output; (3) as a general reserve. It is also useful in that it will burn out a line fault that might damage a generator.

Mr. Highfield estimates plant, exclusive of buildings, at £25 to £50 per kilowatt. Allowing £35 as a usual figure, he finds that at a three-hour rate of discharge a battery costs as much per kilowatt as the mechanical plant. At a one-hour rate the cost per kilowatt is less, and in a lighting plant he would put in a battery one-sixth to one-fourth the maximum station output, which will carry the peak of the load for three hours. The loss in the battery will, it is claimed (we think very correctly), be much less than the loss which results from badly loaded steam plant. On this question the author is sound and accurate, always provided, of course, that depreciation is not excessive. In large stations where there are more units, the battery need only be of such a size as will carry over the *slope* of the load curve during such time as the running units are fully loaded and the extra load is short of the load of an additional unit. But obviously in the case of very large stations with many units, a battery has not the opportunities to show results that occur in small stations.

A tramway station differs essentially from a lighting station in its load curve. The daily load curve of a lighting station

has one huge peak, with a more or less sudden slope from an approximately horizontal line of small load. A tramway load has practically scores of maximum peaks, and as many minimum, every hour, with a nearly horizontal mean all day. This sort of load curve means that the full station capacity is at work all day in order to provide for momentary maxima that come along every few seconds. Yet the mean load on the station may be as small as 15 per cent. and is rarely above 60 per cent. except in large systems in electrical parallel. Usually, the author considers, a traction load may be run with a battery of one hour discharge capacity, as was stated in the ELECTRICAL REVIEW in a recent article, and its cost will be £15 to £18 per kilowatt. The author fully realises the conditions of a traction load, and its effect on the proportions of plant, which amounts to zero as regards the boilers, but is most serious as regards engines, and, further, renders economical types of engine worse than nominally wasteful engines.

Mr. Highfield states the ideal system for traction to be generation at constant load, *i.e.*, the economical engine load for, say, 16 hours a day. The battery is to take charge of all peaks and absorb its charge when the inverse peaks occur, and it is to take all the load when this is small, as when cars are shedding or turning out. He advises a reversible booster to feed the battery, and gives a diagram of the connections, and a description of the windings and operation, with a few curves showing how well the end aimed at has been attained. When upwards of 400 cars are operated the load will, says the author, be fairly even [for 500 cars it may be 80 to 90 per cent. of the maximum if the whole of the cars are run in parallel], and little benefit can be got from a battery, for units will be shut down as cars are shedded, and the last running engine often runs on steam that would otherwise disappear during the night, but it is suggested that there are cases where a small all-night service could be run, and we know districts where workers on night shifts at collieries and ironworks would provide loads. But many large systems are not in parallel; the feeders are independent, and all such feeders are as wasteful as so many small stations. Each feeder should then have its own battery, and such might be in sub-stations. The reduction of the maximum rail return current would enable boosted rail feeders to be dispensed with.

In main-line work the place for the batteries is near the various load centres.

The cost of a battery is said to be about 7 per cent. annually for replating. A battery may, it is stated, have an efficiency as high as 84 per cent. The main economy is that due to working the steam engines at a steady load, while no small saving is effected by shutting down the running plant at slack hours of the day or night.

Mr. Highfield's paper is an excellent and practical contribution to the literature on the subject.

The Law of Nuisance.

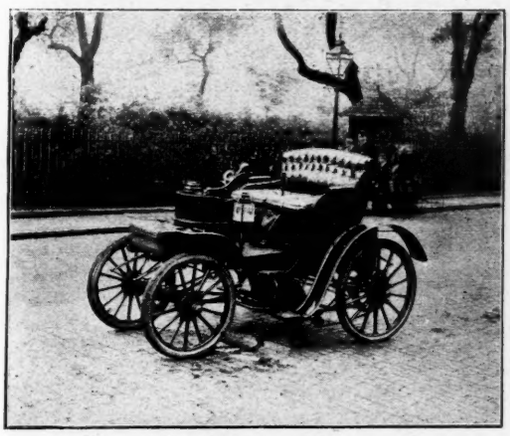
THE case of Hawkes *v.* The Leyton Urban District Council, which has been reported in our columns, goes to show that a supply undertaker cannot afford to ignore an injunction issued by the High Court. When the conduct of the defendant Council in permitting a nuisance came before Mr. Justice Buckley in March, 1900 (see the ELECTRICAL REVIEW, March 23rd, 1900), his Lordship granted a perpetual injunction to restrain them from using their gas engines in such a way as to cause annoyance, but he suspended the operation of that injunction in order to allow the defendants an opportunity of replacing the gas engines with machinery which would create no nuisance. Presuming apparently upon the fact that they are a public body, the defendants ignored this mandate, and a writ of sequestration against them has now been confirmed by the Court of Appeal. A writ of sequestration is issued for the purpose of levying on a person's property on account of his disobedience to the judgment or order of the Court. It may be issued to enforce a judgment against a Corporation, and the sequestrators may enter upon the real estate of the party and take the rents and profits, and also his personal property, and keep the same under the sequestration until the act has been performed and the contempt purchased. It is unfortunate that the Leyton District Council should have allowed the ratepayers' money to be expended in useless litigation, instead of taking immediate steps to remedy the nuisance complained of.

The Westgarth Proposals.

THE proposal of Mr. Tom Westgarth to send a deputation of workmen to study the shops and methods of foreigners, has been taken up by *Cassier's Magazine*, and a meeting of manufacturers has been arranged with a view to carrying into effect the proposal. We can tell the British workman, and the British employer also, what they will find. They are not likely to see any but the first rank of workshops, so that we cannot promise them that both in Germany and France, as well as in America, they will find shops as far behind as they will at home. But they will find shops in advance of almost any shop in Great Britain in regard to arrangement of tools, driving, ventilation and heating. In America they will find the workshops heated, even to an uncomfortable degree, for Americans like shops to work in that are 10° hotter than what is sufficient for ourselves. The Germans also give rather excessive temperatures. The workmen will find their fellow workmen doing ten hours a day instead of nine, or the eight hours that the A.S.E. professed to think worth a six or eight months' strike. On the other hand, the employers will find in the best German shops the fullest regard paid to comfort, and each man provided with a proper place to change and hang his clothes, and facilities for working. One break a day will usually be found, but a good deal of intermediate munching seems to be practised during the long morning of the single-break day, though with the shorter English workday this ought to be needless. The chief thing for all to notice will be the system of stores and tool rooms, the abundant supply of excellent small tools and gauges, and the complete absence of dirt and untidiness. We often think that if the officials of the A.S.E. had been half so solicitous for the well being of the men as they professed to be when asking for an eight hours' day—to cover their attempt to control the shops—they would have demanded more attention to the civilised amenities of life in the shape of lavatory accommodation and shop cleanliness. If the workmen who form the proposed deputation are of the right sort, they will bring back with them some strong arguments against the restricting policy followed by their principal Union, and they should also bring back some pretty strong arguments to hurl at their employers, for they will realise how hopelessly inadequate are many shops in their equipment; they may also, perhaps, recognise how much such inadequacy has been the outcome of Union restrictions. That the programme should be educational, if well carried out, we do not doubt, and it is to be hoped both sides will learn and profit by it. Mr. Westgarth says the men do not believe what is being done abroad, and hence their attitude. But the masters know, and yet how many of them have said to their men, "Abroad they do this and that," and then proceeded to carry it out in its entirety, including the part which may appear to be non-productive? The deputation ought to be a combined one, for faults exist on both sides.

THE MOTOR CAR EXHIBITION.

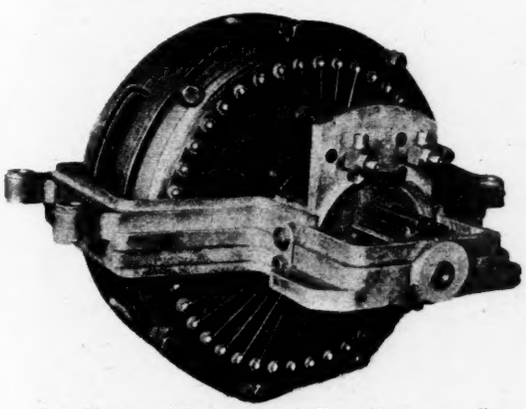
The Automobile Club, and Messrs. Cordingly, the proprietors of the *Motor Car Journal*, jointly, are to be heartily congratulated on the success of the third annual show of motor cars which has just closed at the Agricultural Hall, Islington. It was far and away the best show of its kind held in this country, and the enormous advances now being made in the motor car industry cannot be better illustrated than by comparing it with its two predecessors.



The Brighton Electric Voiturette.

In the show of 1899 and 1900 the number of cars exhibited were approximately 100 to 150; in 1901 it was nearer 300.

The attendance on the opening day, Saturday, May 5th, was a record, and the number of visitors on Monday, Tuesday, and Wednesday of the show week was exceptionally large. The excellence of the exhibits speaks volumes as to the moving spirit that pervades and predominates the whole, and the improvements in the cars are most marked.



Joel Electric Motor.—Front View (Case removed),

The electrical exhibits are yet greatly in the minority, and our readers can appreciate the reasons. With petrol or steam cars there is almost no limit to the distance that can be run; on the other hand, electric cars need recharging after a run of from 30 to 80 miles. This difficulty is rapidly being solved by the facilities afforded for recharging at central electric light stations, such as at Chelsea, &c., as well as by the enterprise of many business firms who have electric light, and are opening their premises for the same purpose. The Automobile Club are preparing a list of electric charging stations, with maps.

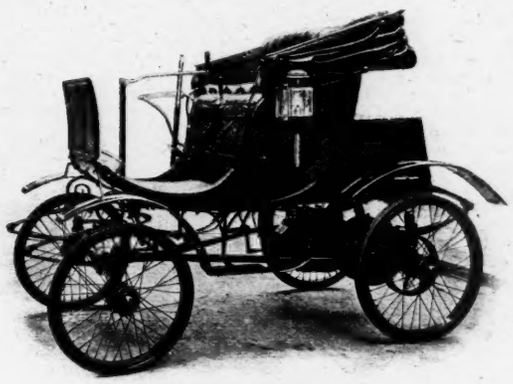
The electric motors, batteries, controllers, and carriages have all had to be specially designed and proved, and this pioneer work has been of a most arduous character. The few who have succeeded, against every discouragement, are to be commended.

To take the electrical exhibitors in the order of the official catalogue:—

Stand 12.—National Motor Carriage Syndicate, Limited, showed "The Brighton" electric voiturette to seat two, with occasional seat in front. Equipped with two 2-h.p. Joel patent electric motors. Speed, 600 revolutions per minute; weight of each motor, 100 lbs.; 36 cells of Rosenthal's patent accumulator, to give 160 ampere-hours, cells made up in four sets of eight cells, and one set of four cells for portability. Total weight of carriage, 17 cwt. Has several times gone from London to Brighton, 53 miles, hilly road, with one charge of electric current, taking 16 units in all, at 3d. per unit, = 4s.

Electric coupé. To seat two inside, with occasional seat, and also seat for driver. Carriage ready for electric motors and batteries shown separately.

Joel patent 2-h.p. electric carriage motor. Weight, 100 lbs.;

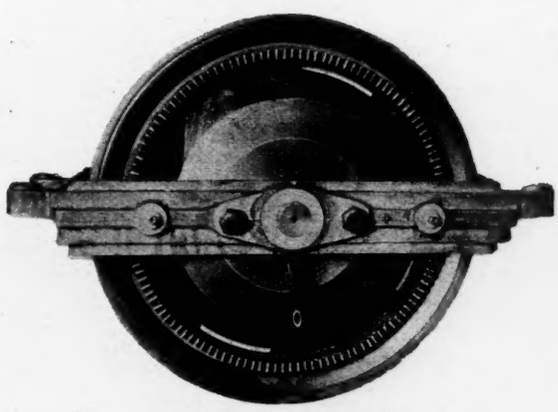


The Oppermann Electric Victoriette.

speed 600 revolutions per minute with 32 volts. This motor has eight poles with armature revolving outside, and is fixed in a cradle ready for mounting on underframe. The motor, when finished, is completely encased in an aluminium cover and protected from dust and water.

Four sets of eight cells, Rosenthal patent batteries; weight of each cell 23¾ lbs.; output, 160 ampere-hours at 20 amperes. Recent tests give 15 watt-hours per lb. of complete cell, which is claimed to be the highest record hitherto attained. These cells we described in our issue of April 5th.

Two cells shown in parts.



Back View (Case removed).

Stand 13.—Carl Oppermann.—The Oppermann electric victoriette, independent weldless steel tube frame; tangent wheels, 27 in. and 30 in. diameter, fitted with 2 in. solid rubber tires; 3-h.p. Oppermann electric motor; safety key, combined volt and ampere-meter; electric lamps; battery of "Flambeau" accumulators. Range of travel on one charge of the battery, 40 to 50 miles. Three speeds and reverse controlled by one lever. Weight of car complete 18 cwt.

Stand 14.—The Doe Portable Electric Light and Power Syndicate, Limited.—A new primary battery; an American invention, the chief features of which are stated to be the absolute constancy of the voltage and the ease with which the batteries can be recharged when run down, without recourse to any external source of electric supply.

Stand 17.—The Meyra Electric Company, Limited, showed dry batteries for ignition on motor cars, motor cycles, gas engines, &c.

Stand 22.—City and Suburban Electric Carriage Company.—Victoriette. As supplied to Her Majesty the Queen. Seated for two inside. Capacity on one charge stated to be 35 to 40 miles at 20 miles per hour; cycle type wheels with 3 in. pneumatic tires.

Mr. Justice Buckley in March, 1900 (see the ELECTRICAL

ought to be a combined one, for faults exist on both sides.

Victoria, rear-driven. Seated for two inside, with coachman and footman outside; 3 in. pneumatic tires.

Landaulette.—Seated for four inside, with coachman and footman outside.

Grand hansom. A luxurious vehicle, specially designed for private use. Seated for two inside, with driving seat in rear.

Omnibus. Seated for 15 persons. Capacity on one charge said to be 25 miles at 10 miles per hour; 3 in. best solid rubber tires.

Stand 47.—Le Carbone (late Lacombe & Cie.) showed their "Sans Pareil" dry cells, for electric ignition of automobile carriages, yachts, tricycles, bicyles, &c. It is claimed for these cells that they are foremost in output and length of life. Carbon brushes for dynamos and motors, rheostats and sparking pieces were also shown. These will be of great interest to electric carriage builders for their motors and controlling gear.

Stand 51.—The Canadian Electric Vehicle Company.—One "Standard" electric victoria to carry three persons, also box seat for driver and footman. Carriage body built by Messrs. Morgan & Co., Limited; batteries by the "Ideal" Battery Company; electric work by the Still Electric Motor Company.

One four-passenger sporting dog-cart, the "Dundee." This type of vehicle has been specially constructed for Highland and hill-climbing work, fitted with Still's patent 6-H.P. duplex carriage motor of special winding, and with six-point reversing controller, arranged to drive at various speeds of about 2, 4, 8, 10, 12, and 14 miles an hour, built extra strong for hard work; supplied in 100 or 200-volt types, according to requirements; fitted with 80 "Ideal" storage batteries.

One English-built electric phaeton, constructed to carry two, three or four persons.

One Canadian-built "doctor's" 30-mile three-wheel electric "runabout," fitted with 40 "Ideal" storage batteries.

One standard type "Oxford" electric phaeton, fitted with 4-H.P. "Still" patent motor.

3-H.P. Still's patent electric carriage motor, showing special winding as applied for hill-climbing work.

Still's patent six-speed electric controller.

Stand 52.—The "Ideal" Storage Battery Company (Shippey Bros., Limited).—Samples of 8, 12, and 16-plate "Ideal" batteries for motor car propulsion in 70, 90, 120, and 140 ampere-hour capacity, suitable for working electric vehicles for 30, 40, 50 and 60 miles' run on one charge of battery power.

Special light-weight accumulators for working spark coils.

One 8-volt "Ideal" lighting set for electric carriage lighting, with lamps complete.

Specimen cells for various purposes.

Stand 85.—British and Foreign Electrical Vehicle Company, Limited.—An interesting display of electrical motor vehicles and batteries as follows:—

Chariot, type A, to carry four people and run 40 miles on one charge.

Chariot, type B, to carry four persons, and to run 40 miles on one charge.

Victoria, with interchangeable brougham body, for two people and a driver, to run 20 miles on one charge, for town use.

One only needs to examine the complicated arrangement of boiler, engines, and mechanism of the steam cars working at 180 lbs. pressure, or the great number of working parts, oiling pipes, and controlling handles of the petrol cars, to appreciate the extreme simplicity and ease of control of the electric carriages in comparison with either, whilst the comparatively noiseless movements of the electric carriages, and the absence of all smell and vibration, have made them very noticeable, and they have been much appreciated. The fact that no restrictions were placed upon their continued running in the large arena of the Hall, whereas the petrol cars were only allowed in for a short period, is an evidence of their safety and other advantages above enumerated.

A NEW THEORY OF WIRELESS TELEGRAPHY.

M. RUDOLF BLOCHMANN, in the *Revue Générale des Sciences*, February 15th, makes an important contribution to the theory of wireless telegraphy, which throws a great deal of light on certain phenomena, for which, hitherto, no satisfactory explanation has been given. For instance, why can wireless telegrams be transmitted to a greater distance over sea than over land, and why are horizontal antennæ less effective than vertical antennæ?

These questions, according to M. Blochmann, are completely answered by taking into consideration the electrical condition of the medium through which the electric waves are transmitted. This medium is the atmosphere near the earth's surface, and the author points out, what has usually been forgotten, that this medium is not in a state of electrical equilibrium, but is subjected to a severe electric strain by the permanent electrostatic charge in the earth. The presence of this charge gives rise to a considerable electrostatic strain in the atmosphere near the earth's surface, which strain may be represented by a series of equipotential surfaces enveloping the earth, as the layers of a bulb surround the central core. At sea these equipotential surfaces are regular and parallel to the earth's surface, but on land they follow such inequalities as high buildings, cliffs, mountains, &c., and are consequently bent and twisted like the geological strata of an Alpine region.

The vertical antenna of a transmitting apparatus pierces these equipotential surfaces in a normal direction, and the disturbances produced by the intermittent charges of electricity sent into the wire have their greatest effect in an axial direction. Violent oscillations in the equipotential surfaces over the end of the wire are produced by the periodic variations of potential at the end of the wire, much in the same way as waves are produced on the surface of a pond by dropping a stone into it. As the waves in the pond spread out over the level surface of the water, so the electric waves spread out in every direction along the equipotential surface, following all the irregularities of its surface.

Electric waves used in wireless telegraphy do not, according to this theory, propagate themselves in straight lines, like waves of light, or very short Hertzian waves. Hence we have an explanation of the well-known fact that wireless messages can be transmitted between antennæ whose tops are, owing to the curvature of the earth, invisible from one another. Irregularities in the equipotential surfaces, as might be imagined, obstruct, to a certain extent, the passage of electric waves over them, and, as a consequence, the distance to which messages can be transmitted on land is not so great as at sea. Experiments made at Mt. Blanc have shown that mountainous regions are unfavourable to wireless telegraphy.

A horizontal antenna is comparatively ineffective because the maximum potential disturbances at its terminals are not normal to the equipotential surfaces. Another important deduction which may be made from Blochmann's ingenious theory is that the antennæ of wireless telegraphy apparatus set up on the edge of a cliff or on a steep hillside should not be vertical, but nearly perpendicular to the slope where they are fixed.

In a country with an irregular surface, the ends of the antennæ of the transmitter and of the receiver, though of the same length, may not pierce the same equipotential surface, and if so this will detract considerably from the efficiency of the transmission. The wireless telegraph engineer in seeking to fulfil this requirement of theory may have to make the antennæ of different instruments of unequal length, or fix them at a certain angle to the vertical.

M. Blochmann does not attempt to explain why long antennæ are more effective than short antennæ, but this appears to be completely explained by the theory of Prof. Slaby, who has shown that the potential oscillations in a wire connected to earth are like the vibrations in an elastic rod fixed at one end, and therefore greater at the free end the longer the wire is. By combining the contributions of Slaby and Blochmann, we arrive at a theory of wireless telegraphy, which, if not complete in every detail, appears to be correct in the main, and which should be of the greatest value to those engaged in the erection and working of wireless telegraph stations. For instance, Blochmann's theory would lead us to predict that the presence of highly electrified clouds between a receiver and a transmitter would render the transmission of messages less effective by the distortion they would produce in the equipotential surfaces; whether or not this has been observed in practice we do not know.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"CRESCENT" writes:—"Can you tell us whether there are any private electric trolley wire tramways running anywhere in Great Britain which cross public roads, and which have not had to get a

few who have succeeded, against every discouragement, are to be commended.

two inside. Capacity on one charge stated to be 35 to 40 miles at 20 miles per hour; cycle type wheels with 3 in. pneumatic tires.

D

provisional order from the Local Government Board? We have a small tramway in hand to be used for the purpose of carrying bricks from one part of a large brickfield to another, where three public roads have to be crossed. The District Council gave sanction to cross these roads, but they now think that they have not powers to grant the application; their clerk has written to the Railway Department of the Board of Trade, and they want to know under what general Act the scheme has been provided. Part of the tramway is at present in existence worked by horses and is entirely over private ground; the roads mentioned are simply country lanes running over the fields, and do not belong to the Council. Can you give us any information on the subject, as to whether it is necessary to have a provisional order in a case of this sort; and if you know of any such tramways in any part of the kingdom?"

*** We are not aware of any private electric trolley-wire tramways running anywhere in Great Britain with or without the sanction of the "Local Government Board;" nor do we think that the Local Government Board has any concern with such matters. The erection of trolley wires over a highway is a matter which primarily concerns the highway authority, and over which the Board of trade, as hereafter appears, exercises a certain amount of control.

With regard to the main question put by our correspondent, namely, Can the local authority authorise the erection of lines over private roads?—it is our opinion that the District Council, as highway authority, would have ample jurisdiction to give their consent to wires being erected across public streets and highways. On this point we would further refer our correspondent to a query put to, and an answer given by, us in our issue of May 4th. Seeing that consent may be given to the erection of wires across highways, it would seem to follow that similar permission could be granted in respect of private roads.

Several queries have been addressed to us upon the point whether provisional orders are necessary in cases of this kind, and we have always expressed the view that a provisional order is not essential for the erection of a private installation—or even for an installation, the object of which is partly to light the premises of its owner, and partly to supply current to neighbours. It is necessary to point out with reference to the erection of cables or wires across streets in pursuance of some scheme which is not sanctioned by provisional order or special Act, that by Sec. 4 (1) of the Electric Lighting Act, it is provided as follows: — "Where, in any case, any electric line or other work may have been laid . . . . over or across any street (which includes highway) for the purpose of supplying electricity, or where any electric line or work so laid down or erected may be used for such purpose, otherwise than under and subject to the provisions of a license, order, or special Act, the Board of Trade may, if they think fit, by notice in writing, require that such electric lines shall be used only in accordance with the such conditions and subject to such regulations for public safety as may be prescribed." Having these provisions in mind, we have always recommended persons in the position of our correspondent to consult the Board of Trade before erecting any works across the highway.

Should it be of any advantage to "Crescent," we might be able to give the names of some of the firms who have consulted us with reference to starting an installation without a provisional order.

TELEPHONES FOR TRACTION SYSTEMS.

The enormous advantages of facilities for communicating with the power station from any point on the line, have led to the installation of telephone connections in the feeder pillars on practically every tramway operated by electricity in this country. The very neat and simple line of apparatus which has been standardised by the General Electric Company (1900), Ltd., especially with a view to fulfilling the requirements of such a service, has been widely adopted for this purpose.

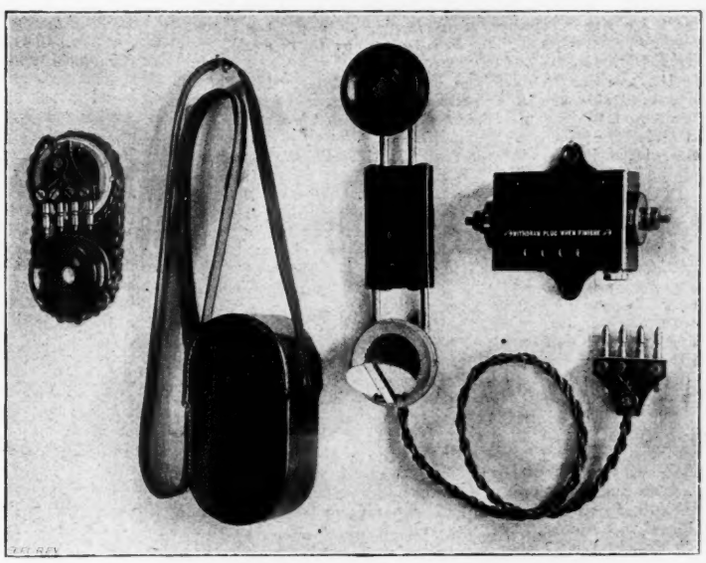
Obviously, there is no need of means for calling up feeder pillars from the *station!* The apparatus at the pillars is, therefore, exceedingly simple, consisting of nothing more than a plug box, shown in the adjoining illustration. This is made entirely watertight, and is provided with lightning arresters (for overhead circuits) on the terminals, which are highly insulated. There are four plug holes, which extend right through the box, so that they cannot get choked up. These contain springy contacts, to ensure good connection with the plugs. The two terminals of the box are connected with two wires, which run into all the feeder pillars and depôts on the system.

The line inspectors are provided with portable telephone sets, each consisting of a telescopic receiver and transmitter combined, thoroughly waterproof, and built to stand rough usage. The leads end in a four-way plug, which can be inserted in the sockets *either* side up with the same effect, so that a mistake is impossible. This set, as will be seen from the figure, can be packed in a very small space and carried in a leather slung pouch, or in the pocket.

The connections are so arranged that upon the insertion of the plug in the socket at a feeder pillar a bell is rung at the power station; the caller listens at the receiver until he is answered *viva voce*. There is an induction coil in the plug box, which is connected with the microphone and receiver by the act of inserting the plug. The connections are of a novel and interesting character; their disposition at first sight leads us to suggest that the induction coil might be dispensed with, but we are informed that excellent speech is obtained. A study of the various details shows clearly that much labour and thought have been expended on the production of instruments combining the maximum of efficiency with the minimum of weight and cost.

Every tramcar also carries a hand combination, with which the driver can call up the power station in any emergency.

The case of depôt stations differs from that of feeder pillars in that it is necessary to provide for calling up from either the depôt or the power station at will, while still making use of the same two wires;



Portable Telephone Set, and Feeder Pillar Plug Box.

this is accomplished by the use of a hand magneto at the power station, and a magneto bell at the depôt in series with a condensers Thus the depôt can be rung up from the power station, yet the two wire. are always on open circuit to *direct currents* when no one is speaking. At the depôt a hand combination set is used, permanently connected to the system, but provided with a switch in the handle; the act of lifting the latter and gripping it calls up the power station, exactly in the same way as the insertion of the plug at a feeder pillar; in fact, in some instances the hand combination is fixed in the feeder pillar instead of using a portable set. It should be noted that no battery is required with this system, except the one at the power station.

The system has been adopted by upwards of 24 British electric tramways.

It is, of course, equally as suitable for police and fire alarm purposes as for tramways, the plug boxes being fixed in pillars or wall boxes; for instance, at Tottenham the District Council has installed a large number of fire alarm stations on this system, which have already proved the value of such ready means of communication.

LEGAL.

Atkins & Applegarth *v.* Castner-Kellner Alkali Company, Limited.

(*Continued from page* 791.)

On Saturday Mr. M. A. Adam was re-examined by Mr. Astbury.

Mr. Astbury: With regard to Nolf, it has been suggested that if the defendants' rocking process were rocked one way, and then stopped for a few moments, then turned up the other way and rocked again and stopped for a few moments, it would be nothing more than Nolf. If it were, do you think it would be any good?—I do not think it would.

Further re-examined: No electrician, reading the plaintiffs' specification, would imagine that fig. 5 was intended to be a working drawing?—The plaintiffs recognised that there would be some caustic produced in the electrolyte. They provided means for counteracting the ill-effects of this amount of caustic which they thought would necessarily get back in some degree into the electrolyte. In the plaintiffs' specification he saw nothing else but directions to make the process continuous. It seemed to witne

by the permanent electrostatic charge in the earth. The

private electric trolley wire tramways running anywhere in Great Britain which cross public roads, and which have not had to get a

that in the whole of that apparatus the idea was to electrolyse into a moving surface of metal.

Mr. Astbury: It was suggested that Donkin's specification was simply to produce sodium, and that the plaintiffs' specification was nothing more. Donkin was dealing, was he not, with the extraction of gold from ores, and the production of an article which was extremely valuable as compared with soda?—That was so, and he did not find in Donkin any directions as to how much or how little sodium he required to get in his mercury.

Further re-examined: He did not see any suggestion of the problem which the plaintiffs held to, set out in Donkin. Donkin did not in any way suggest the advisability of avoiding the production of caustic soda in the electrolyte. Donkin expected it to be produced, and provided a cell which the caustic soda and chlorine so produced would not attack.

Questioned as to Petri, the Witness stated that he had never heard of its being used. The date of Petri was 1886. In 1892 Castner took out a patent for an invention which, in his view, was similar to the plaintiffs. There were no drawings in Petri, to begin with. You could not get a current of electricity to pass through water. In Petri, so far as the water went, there was no provision for making it work at all.

Is there any passage in Petri's specification in which the difficulties which the plaintiffs seek to solve were even suggested?—No.

Was there any possibility of a machine or apparatus if constructed and used—if possible—as suggested by Petri avoiding or curing these difficulties?—No.

Mr. Dugald Clerk, examined by Mr. Terrell, said he had considered Atkins and Applegarth's specification. They did what they proposed to do to get rid of the effect of the local action and counter-electromotive force. The invention in the first claim was general, viz., an improved means for separating alkaline from earthy metals by means of a moving or flowing body of mercury. In the defendants' specification he found the same thing as was described in the plaintiffs' specification, operating with the same results, and by the same means. He had considered the alleged anticipations, but he did not find in any one of them anywhere described the plaintiffs' invention. In Nolf he found a decomposing vessel for decomposing salt and getting the sodium into a body of mercury forming the cathode. There was not a flowing mercury cathode. The process described by Nolf was intermittent, so far as the charging and discharging of the mercury was concerned. Nolf contained exactly the mischief which Atkins and Applegarth tried to get over. The difficulty was the fact that mercury, when charged with sodium, had a very great tendency to act upon the electrolyte, and notwithstanding the electrical forces acting, there was a strong tendency for the sodium to go into the water and produce caustic soda. The difficulty was to keep up the continuous strength of the cathode, and to prevent the sodium going into the water when it was not wanted. Petri's invention was not devoted to the economic production of caustic soda at all. The porous cells in Atkins and Applegarth did not contain in any way the mischief of the porous cells in Petri.

Questioned as to Donkin, the Witness said that the problem that Donkin sought to solve, was a different problem to what Atkins and Applegarth sought to solve. In Donkin there was no suggestion or desire to produce soda. Donkin's invention might succeed very well for the purpose for which he proposed it. He did not find, in Donkin, Atkins and Applegarth's invention.

Cross-examined by Mr. Bousfield: There was no novelty at all in the plaintiffs' specification, except the suggestion that you were continuously to remove the mercury amalgam, and supply fresh mercury. The mere movement was nothing, but it was the removing which was important. That was the only point which could be suggested as novel at this date. There were only two ways of removing amalgamated mercury—one continuously and the other intermittently. Nolf proposed to remove it intermittently. Atkins and Applegarth proposed to do it continuously. A dipping action once in 24 seconds was Nolf's idea to remove it intermittently, but not Atkins and Applegarth's, which was to move it continuously. In Atkins and Applegarth the amount of electromotive force was reduced to a minimum. The defendants' plan was to let the electromotive force be what it liked and to utilise it.

The hearing was adjourned till Monday.

On Monday Mr. Dugald Clerk, further cross-examined by Mr. Bousfield, said that he was of course of opinion that the flowing of the mercury was an advantage, but the most important factor was the removing. Atkins and Applegarth required to make their circulating apparatus go fairly fast.

Mr. Bousfield: In the defendants' apparatus they were enabled to get out their sodium as quickly as they got it in by the use of the cathode?—The Witness agreed.

Prior to this date did anybody, either in text-books or in specifications, ever tackle the problem of getting sodium out of mercury when once it was in?—They had to rely on getting it out by means of water.

I put it to you that in Donkin you have every essential feature of the plaintiffs' specification?—In words there was no essential difference. There was a circulation and a layer of mercury, and there was a movement of the mercury so as to discharge. But Donkin showed no drawings, and did not give anyone an idea of a flowing cathode at all.

Questioned as to Petri, the Witness said that there was no idea given of a moving cathode at the time of charging. Questioned as to Nolf, he said that taking the process as a process for manufacturing amalgam intermittently he did not say that it could not be done, but he did not think it would be successful commercially. There was no difficulty in the flowing of the mercury or in anything else which a practical electrician could not surmount. He had said that in Petri the amalgam would stick to the inside of the porous pot. He had made no experiments on the subject, but his experience told him that the amalgam would close up the pores of the pot. He had read the evidence of Mr. Adam, his partner in the case, and agreed with it. He was not present in Court when Mr. Adam gave his evidence.

Re-examined by Mr. Terrell: If you were treating your apparatus in such a way as to get hypochlorates, caustic soda, or chlorates you were wasting the current so far as the production of sodium was concerned. The tendency to form those chlorates, hypochlorates, or soda was greater when the sodium became rich. The process which in effect prevented the formation or discouraged the presence of rich amalgam was an invention which would tend towards the economy of current; whether that was by reducing the electromotive force or by chemical action. When they had an amalgam of sodium and mercury in contact with water a chemical deposition took place—that was to say, when sodium was produced, and hydrogen given off. That was a known chemical decomposition. The tendency for that decomposition to become accelerated was increased as you got richer in sodium. There was no doubt that the defendants had improved on Atkins and Applegarth in regard to a flowing mercury cathode. Donkin in no way offered an explanation of the problem which Atkins and Applegarth tried to solve. In Donkin there was no idea of economising electromotive force or current. In Donkin the problem was not one to produce sodium economically at all. There was no sufficient indication in Donkin's specification to enable a skilled person to work Atkins and Applegarth at all. In Petri there was nothing to show a man working Atkins and Applegarth how you might economise current.

Mr. E. J. Bevan, examined by Mr. Astbury, said he was a Fellow of the Institute of Chemistry, a Fellow of the Chemical Society, county analyst of Middlesex, and in practice as a consulting and analytical chemist for upwards of 20 years. He had had considerable experience in electrolysis. He was present in Court when Mr. Clerk was first cross-examined. When salt was electrolysed with a still mercury cathode, the resistance to the current increased as the mercury became richer in metal. As soon as you turned your electric current into the electrolyte with a mercury cathode, hydrogen formed at the mouth of the cathode at once, and increased as the sodium got richer. If it were desired to produce the sodium amalgam in the mercury to the best advantage, it was advisable to prevent as far as practicable the formation of caustic and hydrogen. It was impossible to avoid it entirely. There was always a particular amount going on. The Witness at this stage gave the Court the results of different experiments which he had made for the purpose of determining the time and depth of diffusion in mercury of sodium deposited in it.

Further examined, the Witness said that it was a fact that you could get the sodium out of the mercury by water, but if you coupled it up with a current you could do it more rapidly. That was scientifically known before the date of Atkins and Applegarth's patent. If the mercury was kept in a state of being mixed up, you could get the sodium out of the mercury by means of water, provided you made the water surface large enough. If you used a short circuit arrangement you could get it with a much less surface of water. Speaking as a chemist, he was of opinion that Atkins and Applegarth's specification was of value and useful and above anything which had been shown prior to that date. Atkins and Applegarth told them to at once remove the sodium from the action of the water, and to his mind that was the essence of the claim. He did not find in Nolf, from beginning to end, a suggestion of the useful process described by Atkins and Applegarth. He knew Petri's water system—electrically it would not work. The problem which Donkin wished to solve had no bearing on the problem which Atkins and Applegarth sought to solve. The purpose of Donkin's patent was to extract gold from ore.

This evidence closed the plaintiffs' case. Mr. Terrell put in the patent granted to Atkins and Applegarth.

Mr. Moulton pointed out that the defendants did not admit that the plaintiffs had any title to it.

Mr. Terrell next put in two agreements dated November 15th, 1897, and April 7th, 1898, made between Atkins and Applegarth of the one part, and the Commercial Development Corporation of the other part. The learned counsel also put in an agreement dated April 17th, 1901, made between Atkins and Applegarth of the one part, and Mr. F. E. Smith of the other part, and also a certified copy of the register as to the state of the register on April 22nd, 1901, viz., long after the action was commenced.

Mr. Moulton said he was quite prepared to fight out the case on the merits, but when the proper time came he should maintain that the patent in question did not belong to the plaintiffs, but was registered in the name of somebody other than the plaintiffs.

His Lordship said on looking through the agreements, the result of them was that the Commercial Development Corporation were equitably entitled to the patent under the agreement of November 29th, 1897, and that Smith had bought the patent subject to that agreement. He (his Lordship) thought the plaintiffs were entitled to go on.

Mr. Terrell said that after that expression of opinion that would be the plaintiffs' case.

Mr. Astbury said that before Mr. Fletcher Moulton addressed his Lordship on behalf of the defendants, he should like to make some observations on the legal aspect of the matter, and also on the evidence. With regard to the question of title, after his Lordship's expression of opinion, he did not propose to say one word. The first point his Lordship would have to decide was what was meant by a moving mercury cathode? He submitted that the value of a moving mercury cathode was enormous. A misstatement of theory did not matter at all, unless it led the person who was working on

thoroughly waterproof, and built to stand rough usage. The leads end in a four-way plug, which can be inserted in the sockets *either*

trolyte. In the plaintiffs' specification he saw nothing else but directions to make the process continuous. It seemed to witne

the process to do his process wrongly. The learned counsel then cited to his Lordship, cases bearing on this proposition, and the hearing was again adjourned.

Mr. MOULTON, in opening the case for the defence, said that if it had been merely a question of saving time, he should have been tempted to submit that the plaintiffs' case had broken down on their own evidence as regards infringement. But he thought it would be best if they tried his Lordship's patience and asked him to hear the whole case and the whole of the defence set up by the defendants. He should submit to his Lordship that both on invalidity and infringement the plaintiffs' case broke down. On hearing and reading the evidence that had been given, he must frankly confess that he thought his Lordship had a very hard task to get at the real facts and the real substance of the case from the statements of the witnesses. It was natural that that should be so in a case involving scientific principles. He should put before his Lordship a short history of the theory and method of making caustic soda electrolytically by the use of mercury. There were two or three things here which, as far as he could see from the evidence, were in inextricable confusion. The words "back electromotive force" appeared to him to be used by the witnesses in two or three different senses. The theory and practice which the defendants were about to prove was this:—The first idea of making soda from salt electrolytically was the obvious way—and the way Sir H. Davy did it—of simply taking a strong solution of lime, and passing a current through it, leading the current in the solution to electrodes of some substance which could not be attacked. Since that was tried it was discovered that there were two very great disadvantages. The first was that the caustic soda was formed by the sodium which came to the anode instantly combining with water in the brine solution, and therefore you never could get your soda free from salt. Consequently the product was a mixture of soda and salt, useless for commercial purposes. The other difficulty was that this was formed in an electrolyte in which chlorine was set free. The tendency was for the chlorine to attack the caustic, so that this method of electrolytically decomposing brine got to be looked upon as a matter of making hypochlorates rather than making caustic soda, because the caustic soda was made in a form practically useless as it was mixed with salt. They then interposed a porous diaphragm between the two electrodes that to a certain extent kept them apart, in which case you would not get hypochlorates, but a mixture of soda and salt on the one side and the chlorine would mainly go off on the other. That was an improvement, but it was not what you would call a flourishing industry. Of course it was evident that if the soda was made in a form free from the salt it could not be solely by electrolysis, because if so, it must be in the electrolyte, and thus in the presence of brine. Therefore you had to get a decomposition of salt. The sodium had to be formed in your electrolytic cell, but it must not attack the water. The idea struck many people of using mercury as a cathode because it amalgamated immediately with the sodium, while the chlorine went off on the other side. The electrical consequence of that change was that you had to use a distinctly higher electromotive force, because it was harder to tear your sodium apart and to hold it until it was absorbed in the mercury than it was to decompose your sodium in circumstances when it at once attacked the water and turned into soda. To decompose with an iron anode, if an earlier process were followed, you would want 2·3 volts to do the work. To use a mercury anode you would want 3·2 volts, or less than half as much again. The amalgam when taken off could be made to give up its sodium. It was evident that apart from the mere cost of the plant, that was a very much more practical method of making soda, because although it required a certain amount extra of electromotive force to do it, it gave you soda with absolute purity. That represented the knowledge of the world prior to the date of the patent in question. Certainly the world knew that. He did not think that any more practical or plain description of a workable apparatus to obtain pure soda could be given than that of Nolf. That was a plain and very ingenious embodiment of those principles which were perfectly well known to electricians at that time. Although he should not stop then to describe Nolf, in order to prove his words, he should later on ask his Lordship to follow him with regard to Nolf, and to see if he had not described his invention properly. It might be asked then very prudently that when they had got a way in which they could produce this pure soda with only a slight excess of electromotive force over an imperfect method which gave them products so much less commercial value, why was not this practically used? It was not practically used for this reason. Although sodium amalgam in the presence of water ultimately gave up the sodium, it did so very slowly, and it was not at all easy to get it rapidly to disgorge the charge. His Lordship must remember that they were not dealing with stuff which was sold by ounces, but by tons. It was sold at about £6 to £8 a ton, or about 1¼d. a lb., and it necessarily had to be made very cheaply in order to compete with those chemical products which were made all over the country. This process was theoretically perfect, and you could make absolutely pure soda with very little electromotive force, and you could get it out, but it was troublesome to get it, and it would require a great deal of mercury to do it. That was more or less the state of knowledge at the date which was important. So far as the manufacture of soda was concerned, the method of using mercury as a cathode had not taken practical shape. Here then came the plaintiffs' patent. He did not wish to say hard things of a patent he was attacking, but he did not think he should make his meaning clear to his Lordship if he did not explain the light in which he presented this patent, and in which he should place it by his evidence. The main stream of invention was done by the inventors who really worked out problems, understanding them first, and then working them out, and afterwards giving practical solutions which the world could take advantage of. But side by side with these inventors there was always a class of persons with an imperfect knowledge, not very competent in learning or mastering the difficulties of a subject, who put forward patents which were absolutely useless, utterly unpractical, and those patents usually died from an attack of fees. But if they were kept alive for any reason whatever, it might very well happen that the real inventor discovered a way of solving the problem, and then these patentees spring up and show some apparent resemblance between what they suggest in this unpractical manner, and what the real inventor has succeeded in showing, and then they come and claim he has infringed their invention. The alternative is their being paid off, or an expensive lawsuit. His (counsel's) case was that this patent came at a time when what was wanted was practical improvements, when the theory was known, when what was wanted was a useful machine from a practical point of view. The plaintiffs had invented nothing that was practicable, or that could assist anybody. The defendants did not use it. There was merely a superficial similarity, which, when it was looked into, completely disappeared. In 1892 Mr. Castner, an inventor of great ability—recently dead—came upon an idea which was a very clever one. It occurred to Mr. Castner that if he took the charged mercury as an anode, and iron as a cathode, and passed a current through it, then he could accelerate the combination of the soda. By his invention he got his soda in a perfectly pure form, and rapidly. He would charge it in one vessel, and use it as an anode in the other, and use the whole in one circuit. The consequence was that he did it promptly, and disgorged as he got it. There were many different ways in which he could do that. He ultimately decided on the simple method of rocking, which exactly carried out the theory. It was a system of pouring mercury from the gorging cell into another cell where it disgorged. It was obvious you could use quite a moderate amount of mercury, because you were able to disgorge so quickly. Mr. Castner did what Nolf did. Nolf tipped it up and drew it off. The defendants united the two cells, and by tipping they poured from the gorging to the disgorging cells. The description that Castner gave as to the management of this was the only good practical direction that you could give.

His LORDSHIP: There is a continuous flow backwards and forwards?

Mr. MOULTON: Yes, it is like the tide. That is the substance of the step taken. That is the substance of what we did, and by which we made the thing commercially useful. The only thing from Nolf was the intervention of the disgorging cell, and then we added the intermittent movement. What he was going to show was that the plaintiffs' invention was a useless one. He was quite prepared to admit that there was a distinction between the plaintiffs' and Nolf's, and a difference which was clearly expressed in the specification. But it was a difference which made a question of infringement quite unsustainable. He was going to point out to his Lordship that the very essence of the plaintiffs' invention was having a conducting support to a film of mercury. His learned friends had asked whether up to this time a moving mercury cathode had ever been used. The answer was no. But none of these were used before Castner came. The right question would have been whether any were ever used until after Castner. The Castner process which was improved upon by Kellner was the one that really solved the problem. Donkin's was a perfectly sensible and practical method, and that instrument procured an excellent mercurial amalgam. Then there was a regular circulation. In the defendants it was intermittent—a tidal flow. The moving mercurial cathode of the plaintiffs had very particular characteristics, but it could not be better than Donkin's, which worked without the slightest "cooking;" nothing could be more simple in the whole of its construction than this, and it was exactly as described. The plaintiffs' specification had to be read fairly to everybody, to the plaintiffs, to the public, to future inventors, and to those who had previously been at work. And the most important thing to find out was what the plaintiffs said to the public they had done. He contended that there must be no false suggestion in a patent. He did not say that a man might not be ignorant of what he had done. He did not say that there might be no blunders, but the substantial suggestions in the patent must be true. The specification was evidently written by men who did not understand what they were writing about. The learned counsel then dealt *in extenso* with the plaintiffs' specification, and contended that it was invalid for want of utility. He submitted that the invention in every respect was a retrograde step. Nobody suggested that it had ever been worked. The whole basis of the plaintiffs' patent was to show how much better the manufacture could be carried out. If the plaintiffs were right in saying that the way in which they did it was not only not better but very much worse, he submitted it would be an abuse of the patent law if the patent were allowed to stand. That was an outline of the case the defendants proposed to make with regard to the utility of the patent. He would deal with the law on the case and the cases cited by his learned friends when he replied after the evidence.

Mr. JAMES SWINBURNE, examined by Mr. MOULTON, said he was acquainted with the plaintiffs' specification, and also with the alleged anticipations. These methods of working with mercury were on a considerable scale at the time of plaintiffs' specification. On the decomposition of chloride and sodium between iron and carbon electrodes the electromotive force required would be between 4 and 6 volts. The back electromotive force was not a very definite thing. It depend upon circumstances. Nolf's was a practical scheme for producing amalgam of sodium by means of a

mercury cathode. In that case you could get the sodium amalgam, but the question would be how to get the sodium out in order to make soda. In the plaintiffs' specification there was no suggestion of how to get the sodium amalgam out. The plaintiffs' specification was very obscure. It did not say anything as to how you were to deal with the amalgam. The first to suggest a practical commercial method of getting the sodium off the amalgam rapidly was either Castner or Kellner—he could not say which of them. That was the invention which made the process a commercial one. So far as the charging was concerned, he did not see any distinction between what the defendants did and what Nolf did. With regard to discharging, the defendants poured off their discharged mercury into a porous cell, Nolf ran his out by tilting—at least he suggested it. When the defendants ran it off, they ran it off into the disgorging cell. There was nothing corresponding to the disgorging cell in the plaintiffs' specification. Donkin had got it out, but in an expensive way. Donkin's directions were quite clear. If you drew off like Donkin or Nolf, you got mercury amalgam all right. Both Nolf and Donkin would work successfully if they had a method of disgorging rapidly. There was no difficulty in the charging, which was well known. In Donkin there would be a regular flow of the mercury. The flowing of the mercury made no difference in the charge. You must let the mercury lose its fluidity. He found directions in Nolf for that. Of course it was important that the mercury should be pure. So far as taking the sodium was concerned, the plaintiffs' apparatus did not enable them to use any less electromotive force—or very little. But to get caustic soda they wasted it. There was nothing in the plaintiffs' specification to show that they contemplated charging less highly. Plaintiffs' fig. 5 was not practicable at all. He did not see in the defendants' arrangement any arrangement of film or lamina, as spoken of in plaintiffs' specification.

The hearing was again adjourned.

On Wednesday last week Mr. SWINBURNE was cross-examined by Mr. TERRELL, and said that when plaintiffs' patent was addressed to the world it was known that mercury would absorb sodium when presented to it by electrolytic process. It was known that that electrolytic process could be done by chloride of sodium solution. It was known that a chloride of sodium solution submitted to electrolysis would in some conditions simply split up the chloride of sodium, and in other conditions split up the water as well.

Can you say whether it was known?—You can find it, no doubt, in several books—undoubtedly in Faraday.

Was it known that under certain circumstances instead of getting sodium chlorine you might get hypochlorites and hydrogen?—Yes, it must have been known at that date.

You cannot say of your own knowledge whether it was or not?—I cannot remember whether it was known in 1891.

Was it known that by electrolysis of a solution of sodium you could evolve hydrogen and get chlorate of soda?—Yes; you have to apply heating to do that properly. I think I knew these things in 1882. They are quite old.

It was known that you could get by electrolysis something in the nature of an amalgam between ammonium and mercury?—Yes, that was old.

Ammonium was not a metal?—No.

Was it supposed at any time that hydrogen was a metal?—Well, some people believe it now.

Was it supposed that you could get an amalgam of mercury and hydrogen?—I think I have heard of it.

If you have decomposition so as to evolve hydrogen, hydrogen will be on the cathode?—Yes.

And if hydrogen is on the cathode, it will offer resistance to the current?—Yes, you can put it in that way.

It was also known that sodium in contact with water decomposes?—The witness replied in the affirmative.

Producing or releasing hydrogen and combining with oxygen?—Yes.

That might be said to be a chemical reaction, and an electrical reaction?—Yes.

Cross-examination continued: Donkin brought back his mercury, and had continuously to get back sodium in it. The sodium in the slush or water had to be decomposed. At the date of the plaintiffs' patent, he did not think that people making caustic, thought of mercury at all. That was only due to Castner's patent. Donkin did not try to put tons of sodium into the mercury. Economy of energy was comparatively a less important factor to Donkin than the plaintiffs; probably economy of energy, and keeping the electrolyte free from sodium, were not present to Donkin's mind. The keeping the sodium from coming into the electrolyte was something which neither Donkin nor Petri had any reference to.

What is your definition of electromotive force?—The difference of potential between any two points in a circuit measured by the amount of work done.

What is your definition of counter-electromotive force?—An electromotive force going against the current and thereby tending to prevent the flow. It does not act as a resistance, although a resistance also tends to prevent the flow.

What is a cathode? The words cathode and anode are only used electrically in connection with electrolysis?—Yes.

When you talk of anything else but electrolysis, you talk of terminals?—Yes.

And the cathode and anode must be conductors?—Yes.

And part of or connected with the conductor from the dynamo?—Yes. The Witness explained that the words cathode and anode were not used very strictly.

Questioned as to Atkins and Applegarth's specification, the WITNESS stated that the patentees in some places use the word "cathode" as meaning the mercury, in some places as meaning the mercury in combination with the metal support, and in some places as the place where the metal was. Questioned as to the alleged infringement, he said that the whole rocking process in the defendants' machine was completed in 12 seconds. The rocking process was slow, steady and continuous. During the whole period of time that the electric current was passing and electrolysis was taking place, the cathode was moving in relation to the anode. The surface of the mercury was always the cathode. Atkins and Applegarth's patent was the first time when moving mercury was ever used for electrolysing salt. In one sense that was a substantial cause of the success in electrolysing salt because it allowed the sodium to be removed from the electrolyte. A moving cathode was valuable for removing sodium, but not valuable for the purposes of amalgam. Attention was called to the benefits of a moving mercury cathode in consequence of what Castner did; not because of what Atkins and Applegarth did.

Re-examined by Mr. BOUSFIELD: Nolf's was a practical apparatus so far as it went—in getting the sodium into the mercury. There might be in Nolf slight mechanical inconveniences in charging and discharging, but there was no difficulty in doing Nolf. Nolf's was not as good as the defendants' apparatus. From an electrical point of view as to waste of energy and getting the caustic into the electrolyte, there was no defect in Nolf which could prevent the apparatus from being used commercially. The real defect was that the apparatus was not complete, because it did not show means for separating the sodium from the amalgam. Petri disclosed the continuous process. Donkin and the defendants produced quite a weak amalgam. Donkin would probably make a stronger amalgam than the defendants.

Lord KELVIN, examined by Mr. BOUSFIELD, said he had read the specification of Atkins and Applegarth, had seen the defendants' apparatus working, and had seen the other specifications. Nolf allowed the mercury to be at rest and removed the amalgam from time to time. The counter electromotive force was not a thing to be evaded, but to be overcome, in obtaining a commercial product. You could not abolish counter-electromotive force, or substantially reduce it by anything referred to in the plaintiffs' specification. He regarded Nolf's as being a practical arrangement. Donkin's arrangement of having an even layer of mercury was much better than the plaintiffs' arrangement. He had studied the specifications of Petri, Nolf, and Donkin, and he did not see any practical difficulty in any of them in carrying out the processes there described. He did not think that the plaintiffs' specification told the world anything which it did not know before.

Cross-examined by Mr. TERRELL: The cost of electrical energy was a large proportion of the cost of electrolysing salt. It was well known that, according to the nature of the electrode you had in the electrolysis, you would get different results. He was a patentee himself in this branch of electrolysis.

When you gave evidence in the last case you were of opinion that stationary mercury, as described in Kellner's provisional specification, was better than flowing mercury?—The best way was to move one or other of the two compartments over fixed mercury, instead of letting the mercury flow. He thought that the mercury ought to be kept as quiet as possible relatively to the vessel containing it.

It is essential, in this process, for commercial success, that the sodium should not be entirely discharged from the sodium amalgam in the water cell?—The WITNESS did not agree.

Cross-examination continued: He took a patent in 1898 (18,522 of 1898) for flowing mercury. He thought that was a good invention at the time he made it, and a great improvement on the method he was designing at the time.

By means of a flowing stream of mercury you get rid of the liability of the sodium coming out as soda in the electrolyte?—You were bound to get some.

I suggest to you that Atkins and Applegarth, although they say "you will get soda formed in the electrolyte" were mistaken in that, except to an infinitesimal amount, and that they really get very little soda?—I think they get a great deal of soda formed through inequalities in different parts of the cathode.

The object of Atkins and Applegarth, as disclosed by the specification, was an impossible one in the way described, because they could not evade the counter-electromotive force. They had to overcome it. One of the things the patentees said was that they wanted to get the sodium amalgam out of the region of the electrolyte. By that they would economise energy, and they would prevent the electrolyte being contaminated by caustic soda.

Does not the whole of the plaintiffs' specification, speaking as to a chemist, say this:—"You will get oxide of sodium whatever you do, and I am telling you the means of getting rid of it, so that it shall not interfere with your future electrolysis"?—The plaintiffs did not say that they wished to minimise the making of caustic in the outer chamber.

The specification did not convey to him the idea that they were trying to form a sodium amalgam as their principal object.

Re-examined by Mr. BOUSFIELD: At the date of Atkins and Applegarth's patent there was room for a practical apparatus working on known principles.

Mr. E. T. SMITH, manager of the defendants' works, also gave evidence in support of the defendants' case, and the hearing was again adjourned.

On Thursday last week Mr. SMITH was further examined, and said that in his opinion Atkins and Applegarth added nothing to the theoretical or practical knowledge of the subject in question. They confused it. There was no advantage in Atkins and Applegarth's apparatus over either Nolf or Donkin. It was an advantage that

the mercury should be mixed up so that no part should be locally charged. He thought that Atkins and Applegarth's apparatus was the worst in this respect. He had actually worked Donkin's apparatus and it formed mercury amalgam with great ease. It worked with as good a percentage of efficiency as their own machine. It worked at an efficiency of 90 per cent. He had worked the Atkins and Applegarth's apparatus as well as he could, and gave it every chance that he could possibly give it. The total percentage of efficiency of caustic and amalgam was from 40 to 50 per cent. 25 per cent. was the most for amalgam. It went as low as 11. In his opinion caustic soda so mixed up could not be a commercial article.

This being the defendants' case, Mr. MOULTON addressed his Lordship on the whole of the evidence given. He said that the Patent Law had never forgotten the principle on which the monopoly for patents was originally declared to be within the English common law, viz, that there must be a new and useful invention, and that if it was so the Crown might make a grant for a monopoly for a limited time for that invention, but that grant was subject to all the conditions of validity to which grants from the Crown were subjected, viz., that there must be no false *suggestio* to the Crown. In the present case the plaintiffs had a patent not for anything new, but for a better way of putting in practice old knowledge. The more the case had gone on, the more he felt it important to look exactly into what the patent was, because he thought they had been much too favourable to the plaintiffs' specification by reading in it a great deal which was of later date than the patent itself. So far as the formation of sodium amalgam was concerned, it was well known at the date of the plaintiffs' specification that by passing an electric current through a solution of lime between a carbon anode and a mercury cathode, you could pass sodium into the mercury, and that you could draw it off, and use it as sodium amalgam for any purpose that you wanted it. The learned counsel then referred to the specifications of Nolf, Petri and Donkin, and submitted that from the evidence given it was clear that Atkins and Applegarth had told the world nothing new, and that really their apparatus was a retrogression as compared with those of Donkin, Nolf and Petri.

On Friday last week Mr. MOULTON, continuing his argument on behalf of the defendants, said that both figs. 1 and 5 of the plaintiffs' specification were impracticable, and neither of them would do what the patentees said they would. The plaintiffs had a somewhat curious defence to fig. 5. They said that fig. 5 was only a diagram.

His LORDSHIP said that their point was that what was in the specification explained and described what was in the picture.

Mr. MOULTON replied that fig. 5 was very much like the drawings they used to make at school to explain mathematics. He would now come to the two claims in the plaintiffs' specification for the purpose of interpretation. First, there must be a compound cathode. Next, there must be an isolation of the mercury as a film during the time it was acted upon; and thirdly, there must be intensity of action during that period. There were three things which were not to be found there at all; there was no pouring in and out for the removal of the mercury; there was no flux or re-flux acting upon the mercury, and there was nothing about low charging.

His LORDSHIP: The poorness of the mercury?

Mr. MOULTON: The poorness of the mercury. No, nothing whatever. Continuing, the learned counsel said that after Nolf there came the discovery of the method of disgorging by means of an electric current. In the tipping movement used by the defendants, whether it was done quickly or slowly, the defendants borrowed nothing whatever from the plaintiffs. The plaintiffs had not got the pouring in and out and the low charging, and his case was that there had been no infringement at all.

Mr. TERRELL then replied on the whole case on behalf of the plaintiffs, at the conclusion of which his Lordship reserved judgment.

THE MAYOR, &C., OF MIDDLESBROUGH *v.* THE IMPERIAL TRAMWAYS COMPANY, LIMITED.

BEFORE Mr. Justice Wright in the King's Bench Division of the High Court of Justice, on Thursday last week, the case of the Mayor and Corporation of Middlesbrough *v.* the Imperial Tramways Company, Limited, was heard. Mr. Manisty, K.C., and Mr. Cunningham Glen were counsel for plaintiffs, and Mr. Carrington for the defendants. The action was brought to obtain an injunction restraining the defendant company from causing a nuisance by watering their lines to such an extent as to make the road slippery and muddy, and dangerous to passenger, bicycle, and other traffic.

Mr. MANISTY, in opening the case, said the action was brought by the Attorney-General, at the relation of the Mayor and Corporation of Middlesbrough, against the Imperial Tramways Company, Limited, who, by virtue of a provisional order, have a right to run tramways through the borough of Middlesbrough, and to use electricity as motive power. The claim was for an injunction to restrain the defendants from pouring water on to their lines in such quantities as to cause the highway to be in a wet and dangerous condition in respect of its use by the public, and for damages. The method of watering the lines adopted by the defendants was by means of a large movable tank of water attached to the rear of a car, the water running from the tank on to the rails through two iron spouts about 1 in. in diameter. In that way the rails were flooded by the water flowing over the paved margin of the rails, and the slippery surface produced made the roadway dangerous to traffic, especially to cyclists, and a nuisance to ladies and others who crossed the roadway. The electric trams began to run in 1898, and in the following March, in consequence of complaints from persons who had sustained injuries by falling from their cycles in crossing the wet tramway, the Corporation gave the defendant company notice to cease watering and abate the nuisance. The nuisance, however, continued for some time, although Mr. Robinson, the managing director of the company, reduced the diameter of the pipes. The defendant company also agreed to submit a special car or tank to the Corporation for approval, but they had failed to do so. The nuisance continued until 1899, but was considerably abated in 1900. The defendants, he understood, said that the use of water was essential to the proper and safe working of the lines by electricity. Plaintiffs said the lines could be cleared of the mud without the use of water and by the use of brakes or appliances attached to the cars. He would call evidence to show that the excessive watering had caused subsidences to the road's surface and consequent damage which the Corporation had had to make good. For these reasons the plaintiffs asked for an injunction.

Mr. FRANK BAKER, borough surveyor at Middlesbrough, gave evidence as to the excessive watering of the roadway and the consequent damage and nuisance as stated by counsel.

His LORDSHIP said it was evident that the nuisance had ceased some months before the date of the action, and he wished to know what the object of the Corporation was.

Mr. MANISTY said it was to prevent a recrudescence of the nuisance in future.

Mr. CARRINGTON said his contention was that there had never been any nuisance at all.

Mr. GEO. ANDERSON, inspector of nuisances at Middlesbrough; Mr. C. T. JOHNSON, borough engineer and surveyor at Thornaby, an adjoining borough through which the electric trams run; Mr. STEPHEN BARRON, of Eaglescliffe; Mr. RICHARD ARCHIBALD, a Middlesbrough alderman; Mr. GEORGE BAINBRIDGE, town clerk of Middlesbrough, gave evidence as to the nuisance caused by overwatering; and Mr. C. A. BAKER, consulting electrical engineer, of Piccadilly, said that in his opinion water was not the proper thing to use to cleanse the rails of electric tramlines as it led to a loss of electricity. The best way of cleansing the lines was by hand tools.

Mr. CARRINGTON submitted that there was no cause of action existing when the action was brought, and that there was never any nuisance. One reason why the defendant company was compelled to use water was the abominable state of the roads in Middlesbrough which caused dust and grit to get into the tramlines. As to the amount of water used, he might mention that one tank watered 13½ miles if filled four times, and then there was half a tank full left. Roughly speaking, one tank full watered two miles. They made an alteration reducing the size of the pipe to ⅜ths of an inch in August of last year, and that had been used ever since, and there had been no complaints. The system of watering the lines complained of was in use in Plymouth, Bolton and Leeds, and other places, including London. In Bristol they used a pipe ¼ths of an inch in diameter. In none of these towns had there been any complaint of nuisance.

Mr. JAMES CLIFTON ROBINSON, electrical engineer of the London United Tramways, to the Bristol Tramways, and managing director and engineer to the defendant company; Major CARDEW, retired major of the R.E., and now a consulting electrical engineer; Mr. COSMO W. GORDON, manager of the Dublin Electrical Tramway Company; Mr. H. MAYER, surveyor to the Borough Council of Hammersmith; Mr. EVERSON, the manager of the Plymouth Corporation Tramways; Mr. WAREHAM, general manager of the Leeds City Tramways, and some further witnesses from Middlesbrough were called. The professional witnesses said it was absolutely necessary to use water for the safe working and cleansing of the tramlines.

His LORDSHIP, in giving judgment, said that by the admission of the plaintiff Corporation the nuisance ceased early in December, 1899, and that action was not commenced till February, 1900, no communications having passed between them and the defendant company in the meantime. No damage had been proved by the Corporation, and complaints by cyclists seemed to be at the root of the matter. In his opinion the action failed, and must be dismissed with costs.

THE LONDON COUNTY COUNCIL *v.* THE METROPOLITAN ELECTRIC SUPPLY COMPANY.

THIS case came before the Court of Appeal, composed of Lords Justices Collins and Stirling, on Thursday, the 8th inst., on the appeal of the defendant company from an order of Mr. Justice Farwell, dated April 25th last. The case raised a question of interpretation of a section of the London County Council (Improvement) Act, 1899. When the Act was passed the defendant company had a generating station and works for the purpose of electric lighting in Sardinia Street, the whole of which was required to be taken by the County Council for the purposes of the new street from Holborn to the Strand. A statutory bargain was arrived at between the parties, which was embodied in Sec. 58 of the Improvement Act. The dispute arose under Subsec. 7, which provided in effect that the Council before the date of conveyance and lease of the new site (which the Council had to provide for the company), should pay or secure to the satisfaction of the company a sum equal to the costs of erecting and fitting up a new generating station upon the new site with new plant of a capacity to generate and supply electrical energy to an output of not less than 4,000 KW. The plaintiffs contended that this meant that they were only bound to provide a sum equal to the costs and expenses of erecting and fitting up a new generating station with

new plant of a capacity to generate and supply electrical energy to an output of not less than 4,000 KW., and that they were not bound to bear the expense of a new plant of a capacity to generate and supply electrical energy to an output of 5,000 KW., or any number more than 4,000 KW., on the ground that under unusual circumstances a more powerful plant might be required to generate and supply 4,000 KW. The defendants, on the other hand, contended that the sum claimed by them was based on the station and plant being of a capacity to generate and supply such output as a matter of practical commercial working, and that it was impossible for them to generate and supply an output of not less than a fixed amount without having, in addition to the *minimum* plant capable of generating or supplying such an amount temporarily, spare or extra plant in case of a breakdown or repairs. Mr. Justice Farwell held that the plaintiffs were right in their contention, and granted a declaration to that effect. Hence the present appearance of the defendants.

Mr. Cripps, K.C., Mr. Butcher, K.C., and Mr. Sargent appeared for the appellants; and Mr. Haldane, K.C., Mr. C. E. Jenkins, K.C., and Mr. Methold for the respondents.

At the conclusion of the argument, Lord Justice COLLINS, in giving judgment, said it was obvious that in order to ascertain what sum was to be paid by the County Council they must have a decision by competent persons on questions of fact. It was substantially agreed that the matter must go to an arbitrator as to some part of the matters in dispute, and it had been thought desirable to anticipate the arbitration by taking the opinion of the learned judge as to the construction of a point of law arising upon the section in question. The short point of law which the learned judge had to decide was whether as a matter of law the arbitrator was to be debarred from allowing, and therefore calling upon, the defendants to pay for anything more than for such engines which could fairly be graded up to 4,000 KW. It seemed to him that if he were sitting as a judge bound to disengage the question of law from that of fact, he should come to the conclusion that in the section in question the proper directions would be that the sum to be paid would be for such plant as would be required to generate for a reasonable period under all conditions, such as might reasonably be anticipated an energy of not less than 4,000 KW. Dealing simply with the matter as a judge directing a jury, he could not lay down as a matter of law that nothing more than four machines of a capacity of 1,000 KW. would be required to accomplish that purpose, nor on the other hand could he lay down that anything more would be required. That would be for experts to determine, and if they said that four such engines were not competent in an ordinary commercial sense to carry out the obligation imposed upon the plaintiffs of continually supplying an output of 4,000 KW., then the County Council must find the money and pay for anything more that was required. He thought the appeal should be allowed.

Lord Justice STIRLING concurred.

HAWKES *v.* LEYTON URBAN DISTRICT COUNCIL.

THE case of Hawkes *v.* Leyton Urban District Council on Thursday, May 2nd, came before the Court of Appeal, composed of Lords Justices Collins and Stirling.

Mr. H. TERRELL, K.C., said this was a motion for an order staying the issue of a writ of sequestration which Mr. Justice Buckley ordered to issue against the defendants on Tuesday. The action was brought by a resident in Leyton to restrain the defendants from creating a nuisance by reason of their electric lighting works. Mr. Justice Buckley last year made an order restraining the defendants from carrying on their electric lighting works so as to cause a nuisance to the plaintiff. The case came before the Court of Appeal on the appeal of the defendants, and then the order of Mr. Justice Buckley by consent was amended by limiting the injunction to a nuisance by reason of the gas engines used by the defendants. A notice of motion was served in March last for a writ of sequestration to issue against the defendants on the ground that, notwithstanding the injunction, the defendants still continued to cause a nuisance by noise and vibration by the use of gas engines. Mr. Justice Buckley heard the case, and took a strong view against the Council, and ordered a writ of sequestration to issue. From this decision the defendants gave notice of appeal, but they now asked that the writ of sequestration might be stayed until the appeal was heard. The learned counsel stated that if this were not done the whole district would be thrown into darkness.

Mr. ASTBURY, K.C., for the plaintiff, said that the defendants had committed a grave contempt of court, but he should not object to their Lordships expediting the hearing of the appeal.

In the result it was arranged that the appeal should be heard on Monday, May 6th, the plaintiff undertaking not to issue the writ of sequestration until after that day.

The case came before the Court of Appeal, composed of Lords Justices Collins and Sterling, on the 6th inst., on the appeal of the defendant Council against an order of Mr. Justice Buckley made on April 30th, that a writ of sequestration should be issued against them for disobeying the injunction granted in April last year restraining the defendants at the suit of a resident at Leyton from carrying on their works in connection with electric lighting in such a way as to cause a nuisance by noise and vibration. On two occasions the operation of the injunction was suspended on undertakings given by the Council, on whose behalf it was stated that they were erecting steam plant which would be no nuisance. Upon appeal this Court confirmed the order of the Court below, but limited the injunction to noise and vibration by the use of gas engines. The steam plant had since been brought into operation, and it was represented that the gas engines were now only worked for certain hours a day as auxiliary to the steam plant. The plaintiff, contending that the Council had broken their undertaking and disobeyed the injunction, applied for the writ of sequestration which Mr. Justice Buckley granted on the ground that the defendants had deliberately and wilfully disobeyed the order of the Court.

Mr. H. Terrell, K.C., and Mr. Dibdin, K.C., appeared in support of the appeal, Mr. Astbury, K.C., and Mr. A. Beckett Terrell for the plaintiff.

Their Lordships found that there had been a breach of the injunction, but the writ would lie for a week so that defendants might have an opportunity to make application in the matter to Mr. Justice Buckley.

The case came before Mr. Justice Buckley, in the Chancery Division of the High Court of Justice, on Tuesday, this week, when an application was made by the Council for modification of the order for sequestration granted against them by Mr. Justice Buckley and confirmed by the Court of Appeal.

Mr. HENRY TERRELL, K.C., for the Council, said that the order of the Court of Appeal was on May 8th, and on May 9th at a special meeting of the Council, at which all members were present with the exception of four, a resolution was unanimously passed that the clerk should be instructed to make this application for the purpose of telling the Court that the Council were not aware until the motion for sequestration was made that there had been any breach of the order or undertaking; that it was their intention to strictly obey the order, and their desire to apologise to the Court for their disobedience. These resolutions were proved by an affidavit of Mr. Atkins, the chairman. He (the learned counsel) now asked that the writ of sequestration be discharged upon the Urban Council undertaking not to use the gas engines except in the case of emergency.

Mr. ASTBURY, K.C., for the plaintiff, left the matter in the hands of the Court.

Mr. Justice BUCKLEY said he desired to know exactly what the defendants intended to do in respect of increasing their existing steam plant, and for the purpose, would direct the motion to stand over for a month, and suspend the writ of sequestration for that period. By consent he would make an order that the defendants were not to work the gas engines at all, but would give them liberty to apply to be relieved of that order in case of any emergency making it necessary to work the gas engines.

BIRNBAUM *v.* SIMON, BERRY & CO.

IN the Lord Mayor's Court, on May 3rd, before the Recorder (Sir Forrest Fulton, K.C.) and a jury, the case of Birnbaum *v.* Simon, Berry & Co., came on for hearing, and was disposed of. The plaintiff, Mr. Isadore Birnbaum, telephone manufacturer, trading as the Berliner Telephone Company, 117, Queen Victoria Street, sued the defendants, Messrs. Simon, Berry & Co., manufacturers and dealers in electrical fittings and electrical bell accessories, Upper Thames Street, to recover the sum of £14 13s. 8d. for telephones supplied. Mr. Compton was counsel for the plaintiff, and Mr. Sinclair represented the defendants.

The PLAINTIFF said that on January 24th last he called at the defendants' place of business and saw Mr. Simon, one of the partners of the defendant firm. He (plaintiff) had sample telephone instruments with him, and Mr. Simon, after inspecting the instruments, ordered duplicate sets to be sent to each of their branch establishments at London, Birmingham, and Manchester. There were seven instruments to each set. As a condition for further business to be done, he placed the defendants' firm on his best factor's terms. They were to receive the preferential discount of 20 per cent., which was allowed to the factor. There was no mention made at the time that the goods were to be sent on approval, or that they were to be sent on the terms of sale or return. He (plaintiff) had never sent out a single instrument on sale or return. The order was a sale out and out. The telephones were delivered on the same afternoon, together with ordinary invoices. No exception was taken to the form of the invoice. On January 25th, he received a letter from the defendants in the following terms:—"We have your favour of the 24th to hand. We beg to point out that it does not agree with the terms of our letter, and we cannot order same. For goods supplied, say in January, same are paid for between March 4th and 10th, of which please make a note, and if this does not agree with your terms, please advise us, and we will return the samples forthwith." On February 26th the telephones were returned. Up to that moment it had not been suggested that the instruments had been supplied on sale or return.

Mr. VALENTINE HOLT, traveller for the plaintiff, said he had been in the telephone trade for seven or eight years, and he had never heard of telephones being supplied on the terms suggested by the defendants, on sale or return.

Mr. PHILIP FREDERICK SIMON, partner in the defendant firm, was called and said that the plaintiff was frequently calling upon them for orders for telephones, but they had had no demand for them. On January 24th he had an interview with the plaintiff who showed him the good qualities of his instruments. He told the plaintiff that they did not do business in telephones, but that they were always open to do business in any new line. If he (plaintiff) cared to send triplicate samples to each of their respective branches he might do so. There was no mention of terms, as it was not necessary. It was the custom with a great many manufacturers, who knew they were dealers in electrical goods, to send them samples of new lines of goods for them to submit to their branches, and through their representatives to show clients and the trade in general to see if any business could be done. If, after the sample

had been out five or eight months no good result was proved, then the samples were returned and they were credited for the value. That was the arrangement he understood was made in the present case. When goods were ordered by the firm, the orders were generally entered into an order book. The goods now sued for were not entered in the book. Telephones were generally ordered in pairs, but the telephones sent by the plaintiff were single instruments.

Mr. Mossopp, of the firm of Mossopp & Co., electrical engineers, Queen Victoria Street, was called for the defendant, and said his firm dealt in telephones. It was the custom in the trade to receive sample instruments, which were returnable, particularly so in the case of single instruments, which could not be of any use except as a sample.

Mr. Plato, also a member of a firm of electrical bell and telephone manufacturers, stated that the custom, according to his experience in dealing with wholesale houses, was to return samples if the firm was not in a position to deal with them any further.

The Recorder, in summing up to the jury, said that the defendants, in order to establish a custom, must prove an immemorial condition of things and a usage extending over a period of time which was reasonable. It was for the jury to say whether the defendants had proved any such custom as they sought to make out. If the defendants had proved a universal and reasonable custom which could be grafted on to the contract so as to justify them in not making any payment, then they were entitled to succeed in the action. If they had not succeeded in doing that, there must be a verdict for the plaintiff.

The jury found a verdict for the plaintiff for the amount claimed.

The River Plate Construction Company, Limited.

In the Court of Appeal on 6th inst, before Lords Justices Collins and Stirling, judgment was given in the appeal by Mr. Charles Bright from a judgment of Mr. Justice Farwell, who had refused a motion by the appellant asking that an award made in the matter of the arbitration between the River Plate Construction Company, James Capel & Co., and Charles Bright might be set aside on the ground that it was void by reason of its uncertainty, and that the arbitrator had not properly heard and determined the matters in dispute according to the provisions of an agreement between the parties of August 10th, 1899.

The appeal was argued before the Court on Wednesday and Thursday in last week, Mr. Cooper Willis, K.C., and Mr. F. M. P. Schiller being for the appellant, and Mr. Hume Williams, K.C., Mr. Upjohn, K.C., and Mr. MacSwinney for the respondents.

Lord Justice Collins, in giving judgment, said that the appeal must be allowed.

Lord Justice Stirling concurred.

PARLIAMENTARY COMMITTEES.

South Lancashire Tramways.

An important point was raised in connection with this Bill as to the right to supply electric energy in the bulk to local authorities on application. The Bill came before the Earl of Ducie's Select Committee of the House of Lords on Thursday and Friday last week. Mr. Balfour Browne, K.C., Mr. Moon and Mr. Lloyd appeared for the promoters, and Mr. Erskine Pollock, K.C., and Mr. Shaw represented the Lancashire Electric Power Supply Company, who opposed in regard to the supply of electrical energy by the promoters.

Mr. Balfour Browne said the object of the Bill was to authorise the construction of additional tramways, the borrowing of £150,000 for certain road widening put upon the company when before Parliament last year, and also to clear up a doubt as to the right of the company under its present Act to supply electrical energy in bulk to local authorities on application. The Tramways Company, which was incorporated by an Act obtained last year, with a capital of £1,100,000, was authorised to construct a series of linking-up tramways, which were to be worked by electrical traction, in various parts of South Lancashire. Parliament then put upon the company the obligation to light with electricity the roads through which the tramways passed, and they now desired to have it placed beyond doubt that where the local authorities through whose areas their trams ran applied to them, they should have the right to supply them with energy in bulk. The company had no desire to act as distributors of electricity, but only to supply it in bulk.

Mr. Schofield, clerk to the Atherton Urban District Council, having stated that the local authorities desired to take electrical energy from the Tramways Company, so that there might be competition,

Mr. Shaw said the Bill would give the tramway company power to enter into competition with the Lancashire Electric Power Company, which was only authorised to carry out the supply of electrical energy in that very area last year. It was very unfair that the Tramway Company having got their order for a specific purpose, should now come forward and ask for power to compete with the existing company.

Mr. Balfour Browne said they did not wish to supply anybody and everybody, but only where they were asked by the local authorities.

Mr. Shaw said that his company had very great restrictions put upon it by Parliament last year, and the Tramway Company now sought to become a competitor—to, in fact, enjoy all the privileges, but none of the obligations that were placed upon the Power Company. He did not believe that Parliament would ever sanction such a form of competition.

Mr. Balfour Browne said that if it was the opinion of the Committee that the Tramway Company should come under similar conditions to those enforced on the Power Company, they would be quite willing to accept them.

The Committee, after a short consultation in private, announced through the Chairman that they considered the preamble of the Bill proved, subject to the Tramway Company accepting the same clauses as regarded liability and restrictions as were put upon the Lancashire Power Company last year.

Mr. Balfour Browne said he would see that such a clause was brought up.

On Friday Mr. Moon brought up a series of clauses embodying the Committee's decision.

Mr. Ram, K.C., on behalf of the Salford Corporation, asked for a clause to protect the Corporation in respect to any injury done to their gas mains by electrolysis from the tramways of the company.

The Chairman said the Committee considered that the Corporation were amply protected by the Board of Trade clauses, and therefore refused any special clause.

The Bill was then ordered to be reported for third reading.

Bexley Tramways.

After several days' consideration the Select Committee of the House of Commons, presided over by Mr. Seale Hayne, passed the preamble of the Tramway Bill promoted by the Bexley Urban District Council. The Bill proposed to authorise the Council to construct electrically worked tramways in their area, beginning on the far side of their district and joining to the Woolwich and Greenwich Tramway Company's system and the system of the South-Eastern Tramway Company. It was also proposed to construct several lines within the area of the London County Council, but this part of the scheme was dropped on the understanding that the L.C.C. should themselves apply for authority to construct the lines and so join the tramways of the Urban Council. Consequently the opposition of the London County Council to the Bill was withdrawn. The only other opposition was that of the South Metropolitan Gas Company and the Kent Waterworks Company, who feared electrolysis to their pipes and mains, and it was asked on their behalf that instead of the usual Board of Trade model protective clause being inserted in the Bill there should be a special clause inserted, under which the Council would be liable for any damage occurring. The Committee have refused to allow the application of the opponents.

Manchester and Liverpool Electric Express Railway.

On Friday, 3rd inst., a Select Committee of the House of Lords commenced the consideration of a Bill to authorise the construction of an electric express railway between Manchester and Liverpool, to be run upon what is known as the monorail system. Viscount Falkland presided, and a great deal of interest was evinced in the proceedings.

Mr. Balfour Browne, K.C., who appeared for the promoters, opened the case for the Bill at some length. He said the Committee would doubtless remember that last year a scheme with a similar object in view was rejected by a Committee of the House of Commons after a considerable amount of evidence had been given. Sir John Kennaway was the chairman of that committee, and while rejecting the then scheme, they expressed the opinion that the monorail system was likely, when fully matured, to make an important contribution to the development of railway traffic at high speed. They were, however, of opinion that the scheme as then presented was seriously incomplete in many respects, and more particularly, they were not satisfied as to the method proposed to be adopted for applying the brake power. They further added that in their opinion in any scheme put forward for giving railway access to the heart of great cities, the question of an underground approach should be considered and adopted wherever practicable. In the present scheme the promoters had met those objections, as he would show from witnesses whom he would call before the Committee. Having spoken of the necessity that existed for increasing the railway facilities between Liverpool and Manchester, Mr. Browne said that the proposed line would create a new era in railway travelling, for it was proposed to run at the rate of 110 miles an hour, and under the system proposed it could be done with perfect safety. Speed in itself was not dangerous, it was the stopping that might cause the danger, but that would be provided against by the system of brakes proposed to be used. There could be no possible risk of derailment, the danger of collision, owing to the absence of goods traffic and points, was infinitely less than on ordinary railway lines, and there was hardly any possibility of an accident being brought about by a malicious obstruction, seeing that the line would carry current at 500 volts. The capital outlay would be forthcoming, and the promoters believed that the railway, if constructed, would prove a financial success as well as being a great convenience. The only opponents of the Bill were the Salford Corporation, and railway companies who were afraid of competition, but he did not believe the Committee would attach much weight to that opposition, because the main argument for the Bill was that the railway companies at present could not carry the express traffic.

Mr. Behr, who is the inventor of the monorail system, was the first witness. Replying to counsel witness said he was satisfied

from experiments he had made that under the monorail system it would be quite easy to run at the rate of 110 or even 130 miles an hour without risk of derailment. In the event of a train breaking down, a signal would be given to the succeeding train at a point many miles from the scene of the accident. The system of brakes he proposed to apply would be capable of stopping the train within 500 yards if it were running at 110 miles an hour. The trains would be worked by electrical energy equal to 1,500 H.P., and full speed would be attained within 1¾ minutes of starting. The cars would have seating capacity for 60 passengers, and on the basis that only 40 passengers travelled by each train at fares equivalent to those charged by the existing railway the company would obtain gross receipts of £363,852 per annum. It was proposed to run a 10-minute service, and they reckoned that an improved service would tend to a largely increased traffic. Witness then illustrated the saving that would be effected by the use of electricity instead of steam in the working of the line, the working expenses of which, he said, came out at 8d. per train mile, as against 3s. 3d. per train mile on the London & North-Western Railway, and 2s. 8½d. on the Midland Railway. The authorised capital of the line was £2,100,000 with £700,000 in debentures, and to pay a 5 per cent. dividend on the ordinary capital they would have to earn a gross revenue of £186,000. That amount would be obtained if each train only carried 20 passengers, while eight passengers per train would give them sufficient revenue to pay the working expenses.

The Committee then adjourned.

On 6th inst. Mr. BEHR, engineer for the scheme, was again in the witness-box, and in cross-examination by Mr. LITTLER, K.C., who represented the Cheshire Lines Committee, said it was true that the railway would run for a considerable portion of its length alongside the Cheshire lines, and the Cheshire Railway would, if they wished to make a branch, have to go either over or under his line. He did not consider that the railway would interfere with the stations of the Cheshire Lines Committee. He would not object to the clause giving the railway power to carry goods being struck out. With regard to the traffic, he thought the speed of the railway and the traffic facilities it would afford would create traffic. There were several mono-railways other than in the elementary stage. There was one in Russia and one in France, and several in the Colonies. The Ballybunion line in Ireland, which was a mono-railway, was extremely elementary in construction, but at the same time it had lasted for 13 years, and had carried a good many passengers. It was not a fact that on the Ballybunion line the loads had to be carefully balanced. The curves at the Salford end of their line would not necessitate any diminution of speed, and he considered that there was less fear of derailment than on an ordinary line. The lower part of the vehicle was 6 in. from the ground and the floor of the carriage would be 4 ft. 6 in. from the ground.

In cross-examination by Mr. POPE, who represented the London and North-Western and the London and Yorkshire Railway Companies, WITNESS said that it was true that this railway was an experiment in electric traction in a commercial sense, but it was not in any other sense. It was true that there were clauses in the Bill which would allow them to convert the railway into an ordinary electrical railway, but personally he had never contemplated in the scheme anything else than the building of a railway on the mono-railway system, and he was not responsible for the wording of the Bill. He could not branch out between stations, for it would be fatal to the speed to have to stop a train. It was intended to be an express line and nothing else, and he believed the vibration would be less than that of an ordinary express train.

In reply to Mr. FREEMAN, who represented the Salford Corporation, WITNESS said that the route from Salford was practically the same in the present Bill as in that of last year, only instead of carrying it on a viaduct they would pass through the borough in a cutting, very little of which would be open.

In re-examination, WITNESS said that his scheme was not hostile to the existing railways, and he thought it would be rendering a great service by demonstrating that his system was commercially practicable. He did not consider it was a question of improved communication between Liverpool and Manchester, but he believed it would lead to a great development of rapid transit all over the world.

Local evidence was then called as to the convenience it would be to business men to have a rapid means of transit between Liverpool and Manchester.

Mr. R. E. COOPER, C.E., gave evidence as to the route selected, and said that it did less injury to private interests than any other route which could be chosen. In the mono-rail system much better provision was made for wind pressure than was the case on an ordinary line; the pressure would not be greater than 1 ton per cubic inch, whereas the Board of Trade had allowed 5 tons on bridges and other structures. He put the cost of the works at £1,218,306, and the land and buildings at £558,515.

At the resumed sitting of the Committee on Tuesday, 7th inst., Mr. ELLIOTT COOPER was cross-examined by Mr. LITTLER, K.C., and in answer to questions, he stated that the distance between the two mono-rails was 12 ft. 6 in., and the clearance between passing cars 1 ft. 6 in. There would be rather less risk to platelayers than on an ordinary line, inasmuch as a platelayer could take refuge inside a tressel on which the cars ran.

Replying to Mr. ROE RYCROFT, for the Salford Corporation, Mr. COOPER maintained that every consideration had been given to the proposal to carry the line in Salford through a tunnel, but the proposal was impracticable. The question of expense was the least consideration. Apart from the difficulty of working, nobody would travel at high speed through a tunnel of three miles.

Questioned whether this was not intended as a pioneer line, and whether in the event of its success the promoters would not project lines from Manchester to Blackpool and Southport, Mr. Cooper said he protested against being asked questions of such an hypothetical character. He would be asked next whether there would not be soon railway lines all over London.

Mr. J. M. DOBSON, of the firm of Hawkshaw & Dobson, civil engineers, gave confirmatory evidence on the engineering aspects of the scheme. He said he had recently visited the Ballybunion line, and had satisfied himself that the principle of mono-rail was a sound one. He did not experience any of the unpleasant sensations that were alleged against travelling on that line. The Ballybunion line, of course, was a rudimentary one, not comparable in point of equipment with the projected line from Manchester to Liverpool.

Mr. W. R. GALBRAITH, consulting engineer to the London and North-Western Railway Company, said the gradients shown by the deposited plans were favourable to the running of trains at a high rate of speed, and the risk of derailment was met by the method of construction adopted by Mr. Behr. The advantages of the mono-rail were the security against derailment, the avoidance of switches, points, level crossings, shunting and junctions, which made greatly for the safety of the trains and freedom of risk of collision. No doubt the railway to a certain extent was an experiment, and to his mind the route between Manchester and Liverpool was an ideal place for its trial.

Dr. HOPKINSON, of the firm of Mather & Platt, gave evidence regarding the electrical equipment of the line. He said he had been engaged for a number of years in designing and carrying out electrical railways and tramways, and he had no doubt whatever that the trains could be run as suggested by Mr. Behr at a speed of 110 miles an hour. It was quite possible to transmit the power necessary for the railway from the central generating station at Warrington.

Major CARDEW also gave somewhat similar evidence, and said he did not think the line would involve any exceptional risks.

Evidence was also given on behalf of the Bill by Mr. SHELFORD, a civil engineer, who described the experiments he had made with a working model, which he said showed that trains on the mono-rail ran round sharp curves with extraordinary facility.

The Committee adjourned.

On Wednesday last week Major CARDEW was recalled in order to be cross-examined by Mr. LITTLER, K.C. Replying as to the method by which it was proposed to apply the motive power, the witness said he was of opinion that the motors could be placed directly on the axles of the wheels.

Mr. LITTLER said he would suggest that it was impossible to do that in the space at their disposal and yet keep the car below the centre of gravity.

WITNESS said of course he could not profess to design a thing like that at a moment's notice, but he had no doubt whatever it could be done. There were methods by which the electrical conductors could be so protected that no one could touch them. His idea was that with the system of railway proposed there would be wires overhead to take the current, and the rails would only be used for that portion of the current which could be kept at the condenser of the earth, and which would not hurt anybody. If they were not allowed to use overhead wires they would have side conductors, which could be enclosed to whatever extent was desirable. It would be possible to protect the whole of the conductors. It should be remembered that that was not the only railway that had ever been suggested to be electrified. The Central London and the City and South London Railways had both got conductors, and they were only protected at the stations. A wooden guard had been put along the stations so as to prevent the public from touching the conductors. That was done at his suggestion, and the Board of Trade insisted upon it.

M. GERARD, chief engineer and inspector of the Belgian State Railways and president of the Belgian Society of Electrical Engineers, was examined as to the experiments which were conducted at the Brussels Exhibition in 1897 with Mr. Behr's system. He said although it was true that there was some difficulty in getting the necessary power, on the whole the experiments were thoroughly successful, a speed of 75 miles an hour being attained on a curve of 25 chains. He was satisfied as a result of these experiments and his own investigations that the mono-rail system was quite practicable for very high speeds, and that 110 or 120 miles an hour could be attained with safety and with comfort to the passengers. The Belgian Government had accepted the principle of the system, but they had not come to any decision to adopt it.

M. A. DEGRAUX, the engineer-in-chief and managing director of the Traction and Materials Department of the Belgian State Railways, gave somewhat similar evidence.

Mr. S. B. COTTRELL, the engineer-in-chief of the Liverpool Overhead Electric Railway, gave it as his opinion that there was no difficulty whatever about the scheme from an engineering or electrical point of view. He was satisfied that there was no danger of derailment.

Sir W. PREECE was examined as to the electrical equipment of the scheme with which he said he was thoroughly satisfied. The proposal to establish a central generating station at Warrington was, he thought, a good one. Within a limit of 50,000 H.P., the larger the station, the cheaper the energy could be produced. He agreed with the previous witnesses that there would be neither difficulty nor danger in carrying passengers in comfort at a speed of 110 miles an hour.

Evidence was also given by Sir F. BRAMWELL, who said that to his mind the proposed system of construction was well adapted to secure high speed coupled with safety and comfort. The mono-

rail had the same advantage over the two-rail system as the bicycle had over the tricycle. He thought the line would be a great boon to the inhabitants of Manchester and Salford. He did not think there would be any difficulty in applying sufficient brake power to pull up a train which was running at 110 miles an hour in 25 seconds within a distance of 750 yards without any discomfort to passengers.

The Committee again adjourned.

The case for the promoters was concluded on Thursday last week, when Baron de Beeckman, of Brussels, gave evidence as to the absolute security of Mr. Behr's experimental railway at Brussels.

Sir W. H. Bailey, a director of the Manchester Ship Canal, supported the scheme, and stated that he was prepared to subscribe to the necessary capital.

Mr. C. W. Macara, president of the Federation of Master Cotton Spinners' Association, gave similar evidence.

Alderman Bartlett, chairman of the Parliamentary Committee of the Liverpool Corporation, stated that the Corporation favoured the scheme. Where the railway entered Liverpool it only affected a poor class of property.

Several valuers were called to speak as to the value of the land which it was proposed to take.

Evidence was then called on behalf of the Corporation of Salford, who opposed the Bill. The chief point of objection appeared to be that it was not proposed to go through Salford by a tunnel, as was suggested when the Bill was formerly before the Committee.

Mr. J. Corbett, Salford borough engineer, was examined at considerable length, and said he thought the chances of accident could be overcome by the railway going through a tunnel. He considered that the air resistance in a tunnel would be an advantage when approaching the terminus as it would help to stop the train gently. On the other hand, the experience of existing railways showed that whatever additional air resistance might be met when starting would not prevent the train attaining a speed of 60 or 70 miles an hour. He thought the cutting proposed by Mr. Behr did not at all meet the recommendation of the House of Lords' Committee with regard to the underground approach.

On Friday last week Mr. Corbett's evidence was continued. He said that it was proposed to keep the line vertical when going round curves and to trust to the resistance of the guide wheels to maintain the cars in position, but in his opinion the strains set up on the guide wheels, and more especially on the flanges of the carrying wheels on the top rail, which would have to resist nearly the whole centrifugal pressure of the cars, would be extremely likely to cause breakages or derailment. He considered that no proper trials had been made to prove that the system was suitable for express traffic.

In cross-examination, Witness said he considered the mechanical details of the invention absurd, and that it was an utter fallacy to say that one of the great advantages of the line was that derailment was practically impossible. He had had nothing to do with either the construction or working of a railway.

Mr. W. Melville, chief engineer to the Glasgow and South-Western Railway Company, and Mr. Macdonald, city engineer to the Glasgow Corporation, both gave evidence as to the saving which would accrue from having a tunnel through Salford rather than a cutting as proposed by the promoters.

Mr. Brereton, London, civil engineer, gave similar evidence.

Sir Douglas Fox said he was the joint engineer for the construction of the Mersey Tunnel, and was also the engineer for several of the tube lines in London. Looking at the matter from the point of view of Salford the proposed cutting was most objectionable, but he thought a tunnel would obviate the difficulties. His estimate was that a tunnel would cost about £319,000, whereas a cutting would cost £438,000.

At the commencement of the sitting of the Committee on Monday, Mr. Balfour Browne said he wished to make a statement which would perhaps allay some of the fears of the railway company. He was authorised to say absolutely that the promoters had no wish to use the powers asked for in the Bill for other than the mono-rail, and they were prepared to substitute the word "shall" for "may" in the Bill. They were also prepared to agree that no carriage should be run upon the railway unless the centre of gravity was below the mono-rail.

The Chairman pointed out that although the present promoters might not desire to use the line except as a mono-rail, they might sell it, and the purchasers might turn it into an ordinary railway.

Mr. Balfour Browne said that an Act of Parliament would be necessary for such a sale, and the sanction would have to be subject to such a condition.

Mr. Littler, K.C., on behalf of the railway companies, admitted that this was a certain concession, but the question of placing the centre of gravity below or above the rail, was of the essence of the case.

Mr. J. Price, contractor, of London; Mr. Cottrell, manager and engineer of the Liverpool Overhead Railway, and Mr. Elliott Cooper were called, and gave evidence as to the impracticability of making a tunnel as was suggested by the Salford Corporation, and the Committee adjourned.

At the sitting of the Committee on Tuesday, further evidence was given in opposition to the scheme on behalf of the Cheshire Lines Committee.

Sir Douglas Fox expressed the opinion that the proposed line was laid out in an objectionable manner, and would unnecessarily interfere with the Cheshire lines. He did not consider that it would be safe for the railway to run round sharp curves unless the structure were tilted, and in a number of wheels of different diameters, and, therefore, running at different speeds, there was bound to be vibration. He considered the car was of the weakest design he had ever seen. He looked upon Mr. Behr's scheme as purely experimental, and could not see how it was to succeed, while if it failed it would set back the introduction of electrical traction at high speed on other lines. He did not think the train could be brought to a stop in less than a mile.

Mr. F. E. Fox, C.E., said he knew the Ballybunion mono-railway, and considered it a dangerous toy, and objected to the introduction of such a foolish novelty into the railway systems of the country.

Mr. G. A. Rowlandson, chief engineer of the Great Central Railway, gave evidence as to the dangers which would be run by men employed on the permanent way of the proposed railway, and his evidence was endorsed by Mr. A. Ross, the chief engineer of the Great Northern Railway.

Mr. S. H. Short, technical director of the English Electric Manufacturing Company, of Preston, and formerly Professor of Electrical Engineering at the University of Denver, Colorado, said that in his opinion, Mr. Behr's motors were much too small to do the work demanded of them. Each motor, according to Mr. Behr, was to be of 375 H.P., but to attain to 110 miles an hour, it would require four motors of something like 800 to 900 H.P., and he did not know of any way in which, with the space at his command, Mr. Behr could put the motors of the power required on his car. He did not think it was practicable to transmit the necessary power by chain belts, and as to brake power he believed that the best that could be done was to bring the train to a standstill in something over a mile. It was practically impossible to stop the car within 500 yards, and in his opinion the whole scheme was impracticable and visionary.

In cross-examination by Mr. Balfour Browne, Witness expressed the opinion that if the scheme was sanctioned, and it failed, it would stop the development of electrical traction for inter-urban communication for many years to come.

Scotch Parliamentary Inquiries.

The first inquiry under the new system of the Scotch Private Bill Procedure Act, 1899, Commission, sat in Glasgow during the last week. The Earl of Camperdown (chairman), the Earl of Glasgow, Sir John G. S. Kinloch, M.P., and Mr. Charles Gulf Pym, M.P., being the Commissioners. Mr. J. C. Lorimer, advocate, Edinburgh, acting as clerk. The provisional electrical orders down for consideration were:—The Clydebank Tramways Bill, the Paisley Corporation Tramways Bill, the Paisley District Tramways Bill, and the Glasgow Corporation Tramways Bill.

The Clydebank Bill was passed on along with the Glasgow Bill as unopposed measures. The latter refers to extensions to the present system. After several days' inquiry the Paisley District Company's measure, of which Mr. Murphy, of Dublin, is the principal promoter, was passed, while that of the Corporation was rejected. For the accepted measure the counsel were Mr. Henry Johnson, K.C., Mr. John C. Guy, and Mr. J. Fitzgerald Murphy, barrister, instructed by Mr. Turner, Greenock, for the promoters. For the objectors Mr. E. T. Salvesen, K.C., and Mr. James Clark, advocate, for Paisley Corporation; and Mr. James Ferguson and Mr. A. H. B. Constable for the Glasgow Corporation.

London Underground Electric Railways.

On the resumption of the sittings of the Joint Committee on the various underground railway Bills now before Parliament, under the chairmanship of Lord Windsor, Sir Courtenay Boyle, the permanent secretary of the Board of Trade, attended, and handed in a statement from the Board of Trade with reference to the report of the Committee which has been sitting under Lord Rayleigh and inquiring into the subject of vibration. The report was to the effect that the Committee were satisfied, from personal inspection, that there was serious vibration in many of the houses along the line of route of the Central London Railway, and the conclusion they had arrived at was that vibration arose from the large proportion of weight of locomotives not borne on springs, and from want of rigidity in the rails. It was understood, however, that a new type of locomotive had been ordered by the company from America. The engineers were also making further experiments to overcome the difficulties which had hitherto prevented stiffer rails being used, and when the results of these experiments were known the Committee would give a more definite opinion as to what steps should be taken by the company to reduce vibration and what features should be introduced into proposed new lines. The Committee abstained from definite recommendations till these experiments had been made, but they expressed the opinion that under proper conditions the vibration could be prevented. At a subsequent stage the Board of Trade would present their views on the general control of London underground electric railways, and with reference to workmen's fares and trains, &c.

Mr. A. C. Cripps, K.C., who appeared for the London County Council, said the proposed lines of route of the different railways had been carefully considered by a committee, and they were prepared to make a number of proposals for the consideration of the promoters. Counsel pointed out that the London County Council

were very directly interested in the question of railway accommodation for London in connection with the housing question and the facilities which might be given to the population. They were prepared to submit a map to the Committee showing where they thought the proposals of the promoters might be improved upon. They also considered that there should be one set of fares, and in that connection he mentioned that Sir Henry Oakley, the chairman of the Central London Railway, had made an arrangement whereby all persons travelling over that line before a certain hour in the morning should have the advantage of cheap fares.

The CHAIRMAN suggested that the Council should submit statistical information showing the direction in which the growth of population was tending.

MR. CRIPPS promised that this should be done.

The Committee then resumed the consideration of the Brompton and Piccadilly Bill, and the Piccadilly and City route, and Sir DOUGLAS FOX was called with reference to the line from Piccadilly to the City. He considered that junctions on a three-minute service were objectionable, as they would impede the regularity of the service. The route from Brompton to Holborn he considered to be one of the most important for London traffic, and if there was to be any modification of the original scheme, there should be an interchange station at Piccadilly rather than a continuing junction.

Sir J. SZLUMPER, engineer for the Brompton and Piccadilly line, said he regarded the route from Piccadilly Circus to the Central London line and to North London as more important than the route to the City, seeing the amount of accommodation the City now had. He knew of no case where Parliament had prevented a company extending in a direct line, and allowed another company to come in and interpose a short line.

MR. JOHN STAATS FORBES, the chairman of the Metropolitan District Railway, was examined at great length in opposition to the Charing Cross and Hammersmith line. He submitted that the only traffic which would be carried by the line was already catered for by the company he represented.

The Committee then adjourned.

CENTRAL LONDON EXTENSION.

AT the resumed sitting of the Committee on Tuesday, Lord ROBERT CECIL, K.C., opened the case of the Central London Bill. He said it was a smaller scheme than many that had come before the Committee, and it was simply to construct a line from the end of the present tunnel at the Bank along to Liverpool Street and round again to the Bank. There would be no difficulty in constructing the line, and they would be able to give connection with other underground lines.

The CHAIRMAN: I suppose the loops will be single lines?

Lord R. CECIL: Yes. The tube will be taken in a circle, thus joining up the two tubes. It would facilitate the working of the railway, and would have a great advantage of bringing Broad Street and Liverpool Street into direct contact with their line.

Sir HENRY OAKLEY, the chairman of the Central London Railway, said that under their Bill of 1892 they took powers for the extension of the line to Liverpool Street, but that had not yet been carried out. The idea was that the terminal station should be underneath Liverpool Street station of the Great Eastern Railway, but they understood now that the Great Eastern comtemplated providing an underground station for themselves for the purpose of bringing their growing traffic up from the suburbs by means of an electrical line. That, consequently, changed the scheme of the Central London, because it was quite clear that the Great Eastern were entitled to priority on their own ground. They found themselves in this position—that their trains in the morning and evening were very greatly overcrowded. Trains which were designed for 350 people very often carried 500. They put on as many trains as they could get through. The difficulty of increasing the number of trains—which they were willing and anxious to do—was the time occupied at the terminus in detaching and attaching the engines. That originally occupied 3 minutes, and although they had, by extra exertion, got it down to 2 minutes 45 seconds, they found in practice that they could not sustain that during the day, and therefore they came to the conclusion that it would be wiser, in the general interests of the company, and also to secure the connection to Liverpool Street, that they should combine the two objects and make a circular tube, so that the trains might run continuously round, and so save the delay which was unavoidable by the interchange of engines. Under their present system they were always compelled to keep one train idle at the station, but that would not need to be done if they could run the trains continuously. Their manager, who had had experience in the working of a system of that sort, hoped that they would be able to run trains at an interval of every two minutes during the busy parts of the day. That would add something like 60 or 70 trains per day to the present number. At the present time, taking each journey as a train, they ran about 700 a day.

Replying to Mr. Wragg, for the City Corporation, WITNESS said he understood that if the Committee approved of all the schemes now before them, there would be five tunnels under Bishopsgate Street. He supposed they would be made one under the other. They proposed to have three subways at Liverpool Street—one to Broad Street, one to the Great Eastern Railway, and one as an exit for passengers.

In answer to a question by the chairman, Mr. WRAGG said the Corporation were of opinion that the proposed loop should be in some other position.

Replying to counsel on behalf of the London County Council, WITNESS said his idea was that Shepherd's Bush was the limit to which their railway would need to go in a westerly direction, because when one got beyond there the streets were available for electric trams. In his opinion tube railways were only needed for the heart of London where the traffic in the streets was so congested as to preclude the possibility of running trams. Their loop at Shepherd's Bush would admit of their making an extension westward should they so decide later on.

CHARING CROSS, EUSTON AND HAMPSTEAD.

MR. LITTLER, K.C., next opened the case of the Charing Cross, Euston and Hampstead Railway, which he said was practically to serve a purpose which had been before Parliament for more than the last 10 years. On three occasions lines had been authorised, but there had been a great deal of delay, because there was a doubt as to whether tube electrical railways would be a commercial success as far as London traffic was concerned. However, the success of the Central London had induced the promoters to start upon two of the lines. The furthest limit of the present authorised line was at Holly Hill, Hampstead, and the proposal in the Bill was to extend the line under Hampstead Heath further into the country on towards Golder's Green. They at first proposed to have a station on the Heath, but that was very strongly objected to by the local authorities, and therefore the promoters had abandoned that station. They also had a fear that they might injure the Heath by draining it, but that fear was altogether illusory, because the railway at its nearest point to the earth would be 122 ft. below the London clay. The Bill also proposed an extension of another authorised line from Kentish Town to Highgate. The tube would be wider than the existing line of the Central London Railway, which would enable them to obviate any vibration. The tunnels would be 13 ft. wide, and they would be able to do away with the heavy locomotives, and place motors on every vehicle. They would have no locomotive at all, which, of course, would very materially reduce the weight of the train. That method of working was not possible in the narrow tubes, but it was quite possible to do it in the 13 ft. tubes which they proposed to construct.

Sir DOUGLAS FOX gave evidence as to the engineering features and the proposed extension for which he was joint engineer with Mr. Galbraith. All the contracts for the line were in hand, and although the authorised lines only provided for a tube 11 ft. 6 in., they had come to the conclusion that if they were to avoid vibration they must have an enlarged tunnel. They had, therefore, entered into contracts for a tunnel 13 ft. wide, and they hoped to be able to dispense with the use of an electric locomotive and apply the motors to the axles of the cars. Pending a decision by Parliament authorising them to make a 13 ft. tunnel, the whole thing was hung up; and if Parliament refused to sanction the alteration, it would involve the promoters in a loss of some £60,000.

CITY AND NORTH-EASTERN SUBURBAN RAILWAY.

MR. BUSHE, K.C., opened the case for the City and North-Eastern Suburban Railway. It was proposed to begin at Bishopsgate Street and end near Waltham Abbey. There was another line to be taken in conjunction with this Bill, viz., the North-East London line. That line also proposed to start near Bishopsgate Street and go to Tottenham. If it went straight to Tottenham he would have nothing to say to it, but it proposed to branch off and come within the region occupied by his railway. Turning again to his own Bill, he claimed that his line would be the best line to relieve congestion of traffic. Their line started from Bishopsgate Street and went to Shoreditch, and then proceeded to Victoria Park. Six stations would be provided on that section. Then the railway proceeded to Hackney Marshes and thence to Lower Leyton. The entire length of the line was 14 miles, four miles of which were in tube and the other 10 miles in the open. The tube was from Bishopsgate to Leyton. From Leyton the line went to Walthamstow, and thence to Higham Hill, Chingford and Waltham Abbey. There was no question as to the want of greater travelling facilities, for the existing railways admitted that they could not cope with the traffic. The railway company had, however, petitioned to the effect that they were considering what facilities were required. He would submit that no proposals from the Great Eastern Railway to construct electric lines had ever assumed definite shape.

MR. LITTLE interposing, said he objected, on behalf of the North London Railway, to both Bills, and he suggested that it would be best for him to call his evidence after the evidence of both Bills had been heard.

The CHAIRMAN intimated that the Committee would agree to this.

MR. BUSHE, continuing, said it was a pity that a fight should be forced by the North-East London line, because if they would only drop the branch from Tottenham to Chingford Road there was no reason why both lines should not be constructed. They might, if they were friendly, run a two-and-a-half-minute service to Hackney, and then the one line could run a five-minute service to Tottenham and the other a five-minute service to Walthamstow.

The CHAIRMAN said that they must hear all the evidence, and if the Committee came to the question of striking out any particular piece of line then counsel could be heard on that.

CITY AND SOUTH LONDON RAILWAY.

ON Monday the Bill of the South London Railway Company came before the Examiner. The Bill authorised an extension of the time for the completion of the works authorised by the company's Act of 1893, and the raising of £300,000 additional capital.

Electric Lighting Provisional Orders.

The Provisional Orders Bills 3 and 4 were down to be considered by a Select Committee of the House of Commons, presided over by Mr. W. S. Caine, on Monday. It was announced, however, that they were withdrawn from the group, and will consequently go before the Chairman of Ways and Means as unopposed measures. The Bills dealt with the following provisional orders:—

Birstall Urban District Council, in the West Riding of Yorkshire.

Cheshunt Urban District Council, in the County of Hertford.

Hindley Urban District Council, in the County of Lancaster.

Honley Urban District Council, in the West Riding of Yorkshire.

Standish-with-Langtree Urban District Council, in the County of Lancaster.

Stratford-upon-Avon Corporation, in the County of Warwick.

Dorchester Corporation. This Order contained a clause providing that before the water of any river or stream was used for the purpose of generating electricity, the undertakers should fix channels, &c., for the preservation of the fisheries.

Felling Urban District Council, in the County of Durham.

Frome Urban District Council, in the County of Somersetshire.

Lichfield Corporation, in the County of Stafford.

Mitcham Rural District Council, in the County of Surrey.

New Hunstanton Urban District Council, in the County of Norfolk.

Northfleet Urban District Council, in the County of Kent. There was a clause in the Bill that the undertakers should interfere in no way with the banks or shore of the river Thames, or in any way with the rights of the Thames Conservators.

Skipton Urban District Council, in the West Riding of Yorkshire.

Atherton Urban District Council, in the County of Lancaster.

Benwell and Fenham Urban District Council, in the County of Northumberland.

Beverley Corporation, in the East Riding of Yorkshire.

Chesham Urban District Council, in the County of Bucks.

Isle of Wight Electric Light and Power Company. This Order applies to the Urban District of East Cowes, and contains the usual clause for purchase by the local authority at the expiration of 14 years.

Irish Electric Light Provisional Orders.

The Examiner of Bills on Monday considered the Electric Lighting Provisional Orders Bill (No. 10), which conferred powers on the Urban District of Blackrock, the Urban District of Dungannon, the Urban District of Kildare, and the Corporation of Waterford, to supply electricity. The Bills were ordered to be reported to the House.

Kingston-on-Hull Corporation.

The Bill of the Kingston-on-Hull Corporation came before Mr. J. W. Lowther, the Chairman of Ways and Means, on 10th inst. Amongst the powers sought by the Bill, was the construction of electric tramways, the cost of such construction being £27,000.

Mr. Campion called attention to the fact that the power to run omnibuses in connection with the tramways had been struck out. The Bill was ordered to be reported for third reading.

Chester Tramways.

Lord Morley's Committee of the House of Lords on Unopposed Bills considered on Thursday the Bill of the Chester Corporation authorising the construction of tramways in and without the city. The standing orders were found to have been complied with, and the Bill was ordered to go forward.

Wigan Tramways.

The Omnibus Bill of the Wigan Corporation came before Lord Morley's Committee of the House of Lords on 10th inst. as an unopposed measure, and was ordered to be reported. The Bill gives the Corporation further powers with regard to electric lighting and the construction of tramways, amongst other matters.

Leeds Tramways.

The Select Committee of the House of Lords, under the Chairmanship of Lord Dartrey, concluded their consideration of the Leeds Corporation Bill on 9th inst., when the preamble was declared proved. The principal portion of the Bill related to sewage, but power was also asked for to make certain tramway extensions. It was stated in evidence that it was hoped soon to have the whole of the tramways in the town worked by electricity.

Clyde Valley Electrical Power Bill.

The Committee resumed the consideration of this Bill on Wednesday last week, when considerable local evidence was taken in favour of the Bill, after which evidence was tendered on behalf of several burghs which objected to the scheme.

Bailie Keith, of Hamilton, said that the Corporation of Hamilton had decided to start electric works of their own at a cost of £35,000, and had applied to the Secretary for Scotland to obtain borrowing powers to the extent of £40,000. They did not want the Clyde Valley Company coming in to compete with them, as he believed they would be in a position to supply power and light as cheaply, if not cheaper, than any private company.

Mr. Hogarth, consulting engineer to the Hamilton Corporation, gave particulars as to the works proposed to be carried out, and said that it was intended to start on a small scale and increase the output as the demand increased.

Mr. R. Hammond, of London, gave evidence against both schemes. He said he had been consulted by several of the burghs which would be affected by the Bills, and which were averse to private companies coming in and doing what they could do for themselves. There was nothing in the electric lighting orders granted to local authorities which confined them to lighting, and in his opinion if they thought proper they could also supply electricity for power purposes. He only knew of one case where Parliament had sanctioned a rival scheme, and that was at Newcastle, where the two companies had themselves divided the town between them.

Evidence was also tendered by Mr. Manville, of Westminster, of a similar character.

Bailie Wightman, convener of the Electricity Committee of the Govan Town Council, said his Council strongly objected to a private company being allowed to come into the burgh and compete with them. They had expended £35,000 on their installation, and supplied electricity for power as well as for lighting purposes.

Mr. W. M. Mordey, partner in the firm of Mordey & Dawbarn, electrical engineers, Westminster, gave similar evidence, and said that the local authority of Govan having been particularly enterprising in providing for the needs of the locality in the matter of electricity, he did not think a private company should be allowed to come in and compete with them.

Counsel for the various opposing burghs then addressed the Committee, after which Mr. Freeman, K.C., addressed the Committee on behalf of the Clyde Valley Company. He said this was not a case where a company was coming into a district simply to start a financial concern in the hope of its becoming a financial success. The undertaking was formed by gentlemen who were large consumers in the district, not so much because of any profit they expected to derive, but on the ground that the supply was absolutely necessary for their works. It would be impossible to find a stronger local case. The area scheduled was a peculiarly convenient one for the purpose for which it had been chosen, and the scheme was self-united and capable of serving a very large district which required to be served. Some opponents had complained that the promoters had picked out the plums in the districts. His reply was that they had not only taken the districts where a large supply was required, but also those places which might require to be served in the near future. Dealing with the opposition of the burghs, Mr. Freeman said he much regretted that any of the burghs had felt it necessary to assume an attitude of hostility, because the promoters were of opinion that there was protection for burghs in the Bill which was amply sufficient unless the burghs could undertake to supply electricity as cheaply as the company. It would be hard on the traders within the burgh areas that such a Bill as this should be rejected. Geographically, the scheme of the Caledonian Electric Power Company was not so good or convenient as theirs. There was no advantage from an electrical point of view in coupling up Ayrshire with Lanarkshire, unless it was the hope of the promoters to make so much out of Lanarkshire as would pay for any loss in Ayrshire.

Mr. Balfour Browne, K.C., followed in support of the Bill of the Caledonian Electric Power Company. He claimed that his scheme was well designed, could be carried out, and would do no injustice to anybody. The district the company were seeking to supply combined an area that was comparatively poor, with one that was comparatively rich, and he believed that the whole intention of these great power Bills had been that the promoters should take the lean with the fat. Last session the Tyneside Bill was rejected simply on the ground that it took both sides of the River Tyne, just as the Clyde Valley Bill took both sides of the River Clyde and left out the large district of Ayrshire to the south, which the Caledonian Bill included. No doubt had been thrown on the ability of his company to raise the capital required, and a very significant fact in his favour was that all the County Councils concerned approved of the scheme. It seemed to him that the burghs were blind to the advantages which were offered to them. If the burghs could supply energy more cheaply than the companies, then they could keep their customers in spite of the companies; but if, on the other hand, the companies could supply more cheaply, were the Committee going to hand over the manufacturers in such places as Govan, Partick, and Paisley to the tender mercies of the local authorities, to be supplied by them at perhaps twice the price charged by the companies? while, of course, they would prefer to see their own Bill passed and the other rejected, they were quite prepared to see both passed, so that there might be in the district a monopoly regulated by competition.

The Committee then deliberated in private, and the Chairman, in announcing their decision, said that having considered the evidence and the proceedings on both of these Bills, they had arrived at a unanimous decision on all the points. With respect to the Caledonian Bill, the Committee were of opinion that the preamble was not proved, and with regard to the Clyde Valley Bill, they were of opinion that the preamble was proved. But they excised Port Glasgow, Govan, Partick, Paisley and Hamilton. They wished provisions to be inserted similar to those of Sub-secs. 3, 4, 5 and 6 of Sec. 51 of the South Wales Act for the protection of the other local authorities that remained included in the Bill. They also required that Sec. 19 of the General Act of 1882 should not be excluded from the Bill. With regard to Clause 42 of the Bill, they required that to be so amended that the company should not be able indirectly to compete with any authorised distributor in its capacity as the lighting authority. They would leave learned

counsel to bring up amended words to give effect to what they required, their point being that the supply of power should be of such undoubted magnitude, that the use of it for lighting purposes should be subordinated to that of ordinary power.

The Committee then adjourned until Thursday, when the clauses will be considered.

Yorkshire Electric Power Bill.

On Monday the Select Committee of the House of Commons, under the chairmanship of Sir Wm. Holdsworth, which has been considering several electric power Bills, commenced the hearing of the Yorkshire Electric Power Bill. Mr. Pember, K.C., Mr. Baggallay, K.C., Mr. A. V. Frere, and Mr. Egerton Brydes represented the promoters. The Committee will also consider the South Yorkshire Power Bill, which is a rival scheme, and the promoters of this Bill were represented by Mr. Balfour Browne, K.C., Mr. J. D. Fitzgerald, K.C., and Mr. H. Lloyd. There was a very large number of objectors to the Bills, the chief of whom were the Corporation of Sheffield, the Corporation of Barnsley, the Bradford Corporation, the Leeds Corporation, the Halifax Corporation, and the Huddersfield Corporation.

Mr. Pember opened the case, and pointed out that as the Committee had already considered several similar Bills, it was not necessary to go into the history of the principles of legislation embodied in the Bill now before them. Like other Bills, this one was promoted by the large manufacturers and owners of the district, who had formed themselves into a syndicate. There were 63 firms in the syndicate, 13 of whom employed 55,000 hands, having a horse-power of 42,000, and whose works had a rateable value of £216,000. There were about 100 gentlemen in the district ready to give evidence in support of the Bill if it was needed. The district in which the promoters desired to operate was 1,800 square miles. It included and was bounded by Skipton, Ilkley, Benley, Otley in Wharfedale, Netherley, Tadcaster, Selby, Goole, Thorne, Doncaster, Tickhill, Kiveton Park, Rotherham, Handsworth, Saddleworth, Marsden, Rushworth and Todmorden, and included the boroughs of Sheffield, Leeds, Bradford, Huddersfield, Wakefield, Halifax, Dewsbury, Rotherham and Barnsley, and in the district there were 27,000 factories and workshops with a horse-power of 2,000,000. It was proposed to erect four generating stations at Methley, Wath, Thornhill and Bingley, and, roughly speaking, each of the four generating stations would supply electricity within a radius of 16 miles from the generating station. There were five county boroughs, 13 non-county boroughs, and 140 urban and rural district councils in the area. In only a very small part of the area was electricity at present supplied, and nearly all of it was for tramways and lighting. Eleven of the boroughs only had commenced operations on their electrical undertakings, and speaking personally, he could imagine no more uneconomical method of supplying such a district with electricity than for each of the 150 local authorities to commence a supply of their own with separate generating stations and separate staffs. In 1899 only 8½ million units of electricity were sold by nine out of the 11 large boroughs who had generating stations, which was considerably less than was supplied by the City of London Electric Lighting Company. With regard to the local authorities, the promoters desired to conciliate them in every way possible, but they contended that the day of absolute veto was passed. They intended to substitute the following clause for Clause 40 in the Bill.

The powers of the company for the supply of energy under this Act shall be subject to the following restrictions:—

1. Energy shall be supplied by the company only—(*a*) to authorised undertakers, and (*b*) to persons requiring a supply for power.

2. The company shall not supply energy for lighting purposes except to authorised undertakers, or to any railway or water company, or proprietors or trustees of any canal or navigation (for power) in any area which at the date of the passing of this Act forms part of the area of the supply of any authorised distributors without the consent of the distributors.

3. Provided: That where any distributing company refuse or withhold such consent, the company may appeal to the Board of Trade as to whether the consent of such distributing company is unreasonably refused or withheld, and the Board of Trade may dispense with such consent if, in their opinion, it is unreasonably refused or withheld. The consent shall be deemed to be unreasonably refused or withheld if such distributing company are not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time, and in considering what are reasonable terms and what is a reasonable time, the Board of Trade shall, among other things, have regard to the terms upon which, and the time within which, the company are willing and able to give the supply.

4. After any place shall have become the whole or part of the area of supply of a distributing authority, shall not, without the consent of such authority, supply energy in any such place to any person (not being an authorised undertaker, or a railway or water company, or the proprietors or trustees of a canal or navigation) which was not supplied by them previously to such a place so becoming the whole or part of the area of supply of such distributing authority.

The effect of this clause would allow of the Aire and Calder Canal to take its electricity from undertakers other than the local authorities. As to the private companies supplying electricity in the district, it was laid down by Parliament that the granting of an order should not prevent the grant of a competing order, and although they had been willing to treat the local authorities with a certain amount of consideration, that did not apply in the same way to the companies. With respect to the competing Bill, the South Yorkshire Electric Power Bill, they proposed to supply practically the same area, except that the South Yorkshire Company did not propose to take powers for supplying the district to the east of Selby and Doncaster. He did not think it likely that Parliament would prefer the South Yorkshire scheme to the Yorkshire Electric Power scheme, and he said that with some boldness. The promotion of the two companies was of a totally different character. The promotion of the South Yorkshire Company was in the hands of a body of gentlemen, respectable no doubt, but who were not representative of the countryside. Behind the promoters of the South Yorkshire Bill were gentlemen, most of whom had got something to sell. There were Messrs. Mather, of Mather & Platt (Salford), manufacturers of engines and dynamos; Messrs. Galloway, of Salford, also manufacturers of engines; Crossley & Co., makers of gas engines, and firms who constructed electric cables—all first-class firms, no doubt, but not Yorkshiremen as were the promoters of his Bill. Mr. Pember proceeded to deal with the opposition of the boroughs, and pointed out that the Bradford Corporation only supplied 950,000 units annually for power purposes. The Leeds Corporation said they were ready and willing to meet all demands made upon them, but he would point out that most of their expenditure, and the use of the Leeds electric plant had been for their tramways and lighting, and they had only sold 32,000 units for power purposes The Sheffield petition stated that they had acquired the Sheffield electric lighting undertaking under the Electric Lighting Provisional Orders of 1892 and 1898, under which they had power to lay down and maintain electric cables. He was informed that their distribution of electrical power to private consumers in Sheffield had been ridiculously small, amounting to no more than 32,800 units.

Counsel then proceeded to call evidence.

Mr. A. G. Lupton, partner in the firm of Lupton's Woollen Manufacturing Company, of Leeds, called on behalf of the promoters of the Yorkshire Bill, said he was chairman of the company promoting the Bill. There were 66 shareholders in the syndicate, 35 of whom were large employers of labour in the district. The capital value of the latter's works was £216,000, and the number of hands employed at them was 57,000. The works used over 40,000 I.H.P. It was believed by the promoters that they would have no difficulty in raising the necessary capital, which was to be £2,000,000 with the usual borrowing powers.

Replying to Mr. Loder, a member of the Committee, Witness said the Bill was drawn so that the promoters could supply electricity in bulk to the local authorities. They believed they would get an immense demand for the power.

In reply to the Chairman, Witness said the company asked for power to charge their maximum price according to their schedules when they supplied in bulk, but where they supplied individuals, they took power to charge 20 per cent. above the maximum. They wished to leave distribution in the hands of the local authorities.

Questioned by Mr. Russell Rea, a member of the Committee, as to whether Calverley could not be supplied from Bingley, Witness said it was sought to give Calverley two sources of supply. To supply Calverley from Bingley would mean a large *détour* in the laying of pipes. Barnsley was the only non-county borough against the Bill. Practically, the difference between his syndicate and the South Yorkshire syndicate was that there was no contractor for plant on his board. Further, his company's scheme was the largest and the most comprehensive, and was the first in the field.

The Chairman pointed out that the Yorkshire Company's circular spoke of the undertaking being promoted by electricians, engineers and others, suggesting that they might be interested in the scheme as contractors.

Witness replied that the *personnel* of the syndicate had been altered since the circular mentioned by the chairman was drafted. The Cleveland schedule of prices had been included in the Derbyshire and Notts scheme. The promoters of the Yorkshire Bill had two scales, one by which the price diminished as the quantity of power increased, and the other by which the consumer paid by a fixed charge per hour. The promoters' scales had been approved by the authorities supporting the Bill, and they wished to adhere to them. If, however, the Committee decided in favour of the Cleveland scale they would of course accept it.

In further cross-examination, he said that he thought it was possible they would want a wayleave through Sheffield, because they might wish to join up with the Derbyshire and Nottinghamshire Electric Power Company. He was not aware that Sheffield had spent £75,000 last year on their electrical undertaking and contemplated a further expenditure of £100,000. He considered that his company would be able to supply electricity to Sheffield cheaper than the Corporation. He and two other members of the syndicate were members of the House-to-House Electric Lighting Company in Leeds. That company was bought out by the Leeds Corporation in 1893. He did not think it was hard on that Corporation that he was again before Parliament, and that he might have again to be bought out.

The Committee then adjourned till Wednesday.

Derbyshire and Nottingham Electric Power Bill.

This Bill was before Sir W. Houldsworth's Select Committee this week, and a good deal of evidence was given, after which the clauses were gone into, and the Bill ordered to be reported for third reading. Our report of the hearing will appear next week.

London County Council Tramways Bill.

This measure has been before Mr. Seale Hayne's Select Committee this week, and the hearing adjourned.

CORRESPONDENCE.

Where to Construct New Electrical Works.

Your correspondent, writing under the above heading, suggests that you should ascertain what part of this country is best adapted for the purpose.

From the time that millwrights like Brindley became engineers, Manchester has always maintained its supremacy as the metropolis of the great engineering industry of this country, and there is to be found in the Manchester district a far greater selection of capable mechanics than in any other part of the United Kingdom.

In earlier days, when England had practically the monopoly of the engineering industry, the cost of carriage was of hardly any consideration to the manufacturer, as his customer was bound to pay; but in recent years the manufacturers have found that, in competition, carriage is a very important factor, with the result that there has been an exodus of large works from the Birmingham, Sheffield, and other interior districts to the seaports.

As recently as the early eighties, some Manchester works were moved to the seaboard, but it was found that to remove the whole of the Manchester district there would be too great an undertaking, and the simpler expedient of bringing the sea to Manchester was adopted; and the Manchester Docks now accommodate ships of a very large tonnage trading to and from all parts of the world.

The Port of Manchester has given great relief to manufacturers in this district, but as 99 out of every 100 of the existing works were built without any regard to Manchester becoming a Port, the facilities are not available at these old works for obtaining the full advantage of the economies which the new Port provides.

Trafford Park, an estate of 1,180 acres, which, until its acquisition by the Trafford Park Estates, Limited, had been in the hands of one family since the days of King Canute, abuts upon the Manchester Docks at the Manchester end of the Ship Canal.

It has been laid out with every regard to the economies which can be effected by proximity, to the great manufacturing district of the country, to the Manchester Docks, and to the railways and distributing canals of the district.

An arrangement has been made with the Manchester Ship Canal Company by which traffic is hauled to or from alongside any ship wherever berthed in the Manchester Docks, from or to any part of the Trafford Park estate, at a charge of 6d. per ton.

To every plot of land which is leased or sold in Trafford Park a railway siding is given which is connected with the London and North-Western, Lancashire and Yorkshire, Midland, Great Northern, Great Central, and Cheshire lines railways, these being the whole of the railways serving the district.

Electric light and power and fuel gas are available on the estate at low rates.

The British Westinghouse Electrical Manufacturing Company have purchased about 100 acres of land in Trafford Park, and are erecting a very extensive works there.

Before Mr. Westinghouse decided that Trafford Park was the best site for his works in England, he visited sites offered to him near London, near Newcastle, at Liverpool, and also in the centre of England, land being offered to him in the Midlands at a nominal price, but the advantages of Trafford Park outweighed those obtainable elsewhere.

The savings to be effected in Trafford Park are very considerable, and upon this point the following is an answer given at a recent inquiry by Mr. W. P. J. Fawcus, one of the managing directors of Messrs. W. T. Glover & Co., Limited, the electric cable manufacturers, who have removed from Salford to Trafford Park, a distance of only about 1½ miles :—

> We have reckoned that the land we have bought in Trafford Park for the purpose of Glover's works, who are large cable makers, and deal with considerable weights, will not cost us anything. The saving on the carriage over our original site in Salford will be sufficient to pay the rental.

Other firms connected with electrical manufacturing, such as the Lancashire Dynamo and Motor Company, Limited, Howard Conduit Company, Limited, Royce, Limited, the British Electric Car Company, Limited, and Baxendale and Co., have either constructed works in Trafford Park, or have acquired land for their construction.

Marshall Stevens.

This is a most interesting question raised by your correspondent, R. V. Lynn. The question has been to some extent settled practically by the large concerns being started in this country by American enterprise, and by the fact that three large English factories moved from London—one to Bedford, one to Hollinwood, and one to Loughboro'—while we find large electric works at Wolverhampton and Chelmsford.

Anywhere out of London is better than anywhere in, or near it, for engineering works. In the first place, coal, iron, steel, copper, timber, and all raw materials are more costly by carriage, and for other reasons; and in the second place, the cost of workmen's living in or near London is much greater than in the provinces. Consequently, to get equally good hands, higher wages must be paid.

The housing of the working classes in London is disgraceful. An engineering workman in Yorkshire or Lancashire can get a comfortable decent dwelling for 4s. 6d. to 5s. a week, including gas light; the same accommodation could not be got in London for 8s. or 9s. a week, and then he would have to spend time and money travelling to and from work.

In choosing a site for a factory, many considerations must be taken into account; some industries must be carried on in or near the place where the market for the products are; others must be carried on where the raw materials are obtained.

But these considerations do not apply to electrical engineering. The market is the whole world. The site for these works should be located in a mechanical engineering district, where skilled workmen are plentiful, and where they can live decently with their families on the standard scale of wages.

The factory must be taken to the workers. Workers do not migrate to far-away factories in any large bodies.

It may be worth while, in discussing this labour question, to refer to a striking instance of the necessity for carefully choosing a location for a large factory.

Twelve years ago some Scotch firms foresaw a great market in our Colonies for superior cut and materials in ready-made clothing. It was found impossible to get the most satisfactory workers in Scotland. Leeds was chosen for the location, first, because of a plentiful supply of the right class of workers; and, secondly, the cloth could be bought from the looms in the district; and, thirdly, coal and other accessories were fairly cheap. Result, three large well-built modern-fitted factories were built, one of them, to be thoroughly up to date, being fitted throughout by motors and electric light. Here we have three more examples wherein it was necessary to move large businesses from one large city to another on account of local circumstances.

The Manchester district has been much favoured by electrical engineering firms.

Glasgow is, no doubt, a large working centre of engineering, but Glasgow is large enough to begin to suffer from the same evils as the London working centre. The housing of the working classes in the Govan, Partick, Bridgeton, and Springburn districts of Glasgow leaves a lot to be desired. They are rack rented, the house owners in Glasgow demand high rents, yearly tenancy, and municipal taxes are high. Therefore labour is expensive, while raw material for engineering is fairly cheap.

The moderately sized towns or cities seem, on the whole, to offer most advantages, other things being suitable, good railway service, and so on. Leeds is a good example of a favourable location; coal, iron, steel, and other materials are at hand, labour is plentiful, and living cheap.

There are, no doubt, other towns equally well adapted, but Leeds is a good example. It is connected by canal and four railways, has an extensive system of electric tramways, so that the population is spreading out into the suburbs, and the only thing it wants is a supply of cheap electrical energy for power purposes.

The question, of course, only concerns really modern factories designed to carry on a large home, foreign, and Colonial business in heavy electrical engineering, conducted in modern style. We have many small firms all over the country to whom the question is of no interest, electrical engineering having been started with most of them as an adjunct to another established business. Except locally these cannot hope to compete with the large factory, the site carefully chosen, and the whole completely equipped with special machinery and with a highly trained staff of technical experts.

There have been exceptional cases where a factory has moved from a town right into a wilderness. A case in point was the Glasgow Singer's sewing machine factory, which moved from Glasgow to a very small village further down the Clyde. They had to run special trains night and morning for workers until a small town grew up in the neighbourhood. The move was successful. Port Sunlight, on the Mersey, is another case. But these are exceptions to the rule that the factory should be located in the midst of the necessary kind of labouring people. The "living wage" has a deal to do with the question. If a factory has to pay a standard wage wherever it may be situated, then from a labour point of view that site is best where living is cheapest, and this holds good even where no standard wages are paid.

Rankin Kennedy.

Central Driving for Motor Cars.

It has long appeared to me that the very great increase in weight of a vehicle, caused by carrying the motive power inside it, instead of harnessing it in front, may well raise a question as to the wisdom of retaining the old form unaltered. For instance, in a heavy steam-car, to perch the boiler directly over the steering wheels cannot surely be right; and in electrically-propelled vehicles also, there is a tendency to place too much weight in the same direction. In the latter case it has seemed to me that the difficulty might be met in the following way:—

1. Inside a frame consisting essentially of two parallel beams tapering towards the ends, so as to be strongest in the middle.
2. Mount this frame on a pair of *centrally situated* driving wheels of somewhat large diameter.
3. Add a pair of steering wheels at *each* end, the two pairs being connected so as to turn together in opposite directions.
4. Suspend a platform from the frame to carry accumulator cells, half being arranged on one side of the driving axle and half on the other.
5. Complete the superstructure, fit in motors, and adjust the various springs so as to distribute the weight to the best advantage, the large central driving wheels bearing the lion's share.

N.B.—That wheels should be regulated as to size according to the weight they carry is a well-known maxim.

Alfred J. Allen.

London Institution, E.C.,
May 7th, 1901.

Gas Engine Plant.

Enclosed sketch shows gas engine plant running here. I should be pleased if you, or any of your readers, will answer the following:—

Is it possible for one dynamo, when running in parallel with two others, as shown in sketch, to give out more current than the others, providing the voltage on all is the same, viz., would it be possible to get out of the 600-ampere dynamo 500 amperes, and only 200 out of each of the other two?

Speeds, &c., given on sketch.

Remember, it is gas driven.

G. F. K.

[The sketch showed two 600-ampere and four 400-ampere dynamos, driven by two high-speed gas engines, and two of lower speed.]

Certainly, by adjusting the excitation of the various dynamos, the load can be divided in any desired proportion, the terminal pressure remaining the same for all.—Eds. Elec. Rev.]

Resistance Material.

I should be much obliged if you, or any of your readers, can inform me where it is possible in this country to obtain material suitable for the construction of main resistance boxes for absorbing the loads of large generators. The material should be non-magnetic, possess a comparatively low temperature coefficient, and should not exceed in price 2d. per lb. A few years ago I was able to get manganese steel fulfilling these requirements, rolled to section order, but now about 2s. 6d. per lb. is asked for the same thing.

It seems unfortunate that trade should be sent out of the country for material of this kind.

Non-Magnetic.

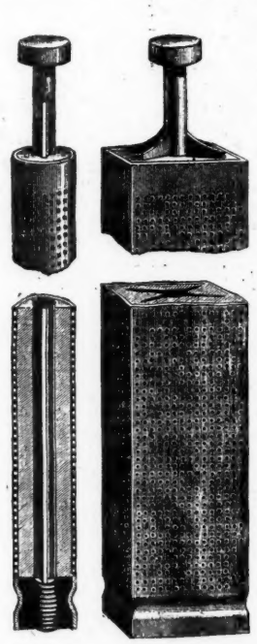
Accumulator Design.

Some time ago the Electrical Review published a notice of a so-called new accumulator designated by the name of "Monobloc."

With regard to this, allow me to say that this accumulator is precisely like the one that I designed and patented on January 18th, 1890, No. 203,249. In fact, my accumulator consists (like the "Monobloc") of a certain number of perforated tubes, whence the name of "multitubular," which I gave it.

The accompanying figure shows the details of an electrode with circular, square, or rectangular section.

Each electrode, whatever may be its shape, consists of a tubular case or sheath of metal (lead or antimoniated lead), or of insulating material, either stiff or elastic (ebonite, celluloid, porcelain, india-rubber, &c.), perforated with a



number of little holes. In the centre of this tube or sheath is fitted a rod of lead or other suitable metal or alloy, and acting as conductor for the current.

The empty space between the rod and the tube is filled with active material, preserved from falling or becoming disintegrated by the perforated case that encloses it.

Now, the "Monobloc" accumulator is characterised by these very perforated tubes filled with active material, in the midst of which is placed a rod of lead serving to convey the current. How then does the "Monobloc" accumulator differ from mine?

In the two accumulators in question we find the same tubular form, the same arrangement of a central rod, serving

as the Lancashire Dynamo and Motor Company, Limited,

really rather as a conductor than as a support for the active material, and lastly, the same perforated case for preventing the falling of the active material, and consequently the formation of short circuits, and the distortion or warping of the electrodes.

D. Tommasi.

Paris.

THE KINGSLAND MECHANICAL SURFACE CONTACT SYSTEM.

We intimated in our last issue, in the illustrated article descriptive of the Kingsland mechanical surface contact system for electrical tramways, that we would defer criticism until we had inspected the working of the apparatus on the experimental track in Wolverhampton.

This we were enabled to do last Friday, when the Kingsland Syndicate invited a few representatives of the technical press and of some provincial newspapers, to view a car in operation.

The first experiment was shown in the workshop on a switch box, in which the star or tappet wheel was revolved by the action of a striker attached to the periphery of a fly-wheel driven by an electromotor at varying speeds, to represent 8, 10, 15, &c., miles per hour of an actual car.

The number of revolutions of the fly-wheel representing a speed of eight miles per hour, is 44 per minute. The circumference of the wheel is approximately the distance between two studs, viz., 18 ft., so that it very nearly represents the effect of front and rear striker on the car itself. The test, however, is a much more severe one than can occur in actual practice; for whereas with a five minutes' service the switch is only actuated 24 times per hour, with the fly-wheel it is actuated 2,640 times.

Every switch was tested for about half an hour before being put out on the line: but a special test of some 60,000 or 70,000 blows was made with the first switch constructed. That test was most satisfactory, and the wear was found to be practically *nil*. Moreover, that test was made with a *rigid* striker, which gives a much more severe blow than a spring striker. As regards this question of wear, which several of the visitors, labouring, probably, under a misapprehension, seemed to think was a serious matter, and likely to give rise to trouble in a comparatively short period, one must bear in mind that the commutator and other moving parts only go one-sixth of a turn at each blow.

We are informed that never under any circumstances has a star-wheel been broken, though they have repeatedly been tested under a falling weight, and with a rigid striker, up to a speed of 20 miles per hour. With a spring striker the impact of the blow is taken principally on the spring.

The company then inspected a car in operation on a length of track of about 200 yards, with a curve of 60 ft. radius. The studs are set 18 ft. apart on the straight, and 14 ft. on the curve. The car ran at about 10 miles per hour on the fastest bit of the line, that is, about the middle of the straight.

As there is no such thing as absolute certainty of action in any mechanical device, it is possible that some day one of the studs may be left alive; the experimental car was provided with no means for overcoming this important objection, but no doubt this defect could be remedied by employing an earth-connected brush at each end of the car, to put each stud to earth directly after the skate has left it. This would blow a fuse in the switch box of any faulty stud, and so render it harmless.

It may be said that the star wheels can be operated by mischievous persons—"the man in the street," of whom we hear so much. This must be admitted; but Mr. Kingsland has devised two methods of minimising the objection, one of which—a cover plate over the star-wheel—was indicated in the section of the track in our last issue, and even if a stud should be made alive in this way, the first car that passes will cut it out altogether.

The slot is only $\frac{5}{8}$ in. wide at the rail head, so that no large stones or other obstructions can enter it; mud, &c., can be removed by means of a scraper, falling into the outer switch box at each star wheel without affecting the latter.

It is of course impossible to get a shock from any part of the apparatus, except a live stud, which can only be reached beneath the car.

We have been much interested in Mr. Kingsland's clever and original device, which we consider to be eminently practical; indeed, it is the only surface contact system on which we would pin our faith for a permanency. The Tramway Committees of those towns which are about to introduce electric traction on their lines, but where for æsthetic reasons the trolley system is objectionable, and the conduit too expensive or inexpedient, would do well to thoroughly inspect the Kingsland mechanical surface contact, which seems to be the happy medium between the other two. Mr. Kingsland deserves success commercially, and we doubt not but that this will speedily come, for he has certainly achieved it from the engineering point of view.

[There appears to have been some misapprehension regarding the arrangements made for publishing the description of the Kingsland system; a contemporary even accuses us, in offensive terms, of taking an unfair advantage by premature publication.

Whatever arrangements may have been made with our contemporaries, we received no intimation whatever on the subject. Mr. Kingsland himself called at this office, and furnished us with information, not only then, but afterwards by post—yet not a word was said as to the date of publication. We hold ourselves blameless in the matter.]

ELECTRICAL ENGINEERS R.E. (VOLUNTEERS).

Regimental Orders.

1. Oil Engine Instruction.—Portsmouth, Isle of Wight, and Milford Haven Camps at Headquarters, Mondays, 6.30 p.m. Harwich and Gravesend, Tuesdays and Thursdays, 6.30 p.m. Sheerness and Plymouth, Wednesdays, 6.30 p.m. Falmouth, Fridays, 6.30 p.m.
2. Recruit Drills.—Tuesdays, 6.30 p.m.; Thursdays, 7.30 p.m. to 8.30 p.m.
3. Non-commissioned Officers' Instruction.—Wednesdays, 6.30 to 8 p.m.
4. South African Contingent.—The under-mentioned Volunteer has been accepted for service with the South African Companies of the Electrical Engineers:—Vol. No. 390, Sapper G. W. Peart, dated May 6th, 1901. Promotions.—No. 8,577, Sapper G. W. Peart to be promoted to Second Corporal in the S.A. Companies Electrical Engineers.
5. South African War Medal Ribbon.—The General Officer Commanding Home District has approved of the Electrical Engineer Volunteers, who are entitled to the South African War Medal, wearing the ribbon on "Undress Uniform." The ribbon will be worn on the left breast of the blue serge, and will be sewn on $\frac{1}{2}$ inch wide, no raw edges to be exposed.
6. The under-mentioned having been enrolled, are taken on the strength of the corps:—Regimental No. 540, S. E. Blakeney; 541, F. W. Jordan; 542, C. A. Proctor (bugler).

(Signed) R. S. Erskine, Major,
O.C.E.E.R.E.V.

BUSINESS NOTES.

Books Received.—"Conduit Wiring and Erect n By L. M. Waterhouse. London: S. Rentell & Co. 2s.

"The Motor Engineers' and Electrical Workers' Handbook West Park, Ohio: William Lintern. London: E. & F. N. Spon Limited. 2s. net.

"Electric Lighting," Vol. II.; "Distributing System and Lamps. By F. B. Crocker. London: E & F. N. Spon, Limited. 12s. 6d.

Meeting of Creditors.—A meeting of creditors has been held this week of Messrs. J. Sunderland & Co., electrical engineers, Victoria Works, Gibbet Street, Halifax. The statement of affairs presented on behalf of the firm showed liabilities to unsecured creditors, £451 13s. 11d.; creditors partly secured, £1,857 9s. 8d.; estimated value of securities, £362 10s.; leaving to rank, £1,494 19s. 8d.; total unsecured liabilities, £1,946 13s. 7d. Assets—stock in trade (at cost price), £1,038 2s. 11d.; working plant, fixtures, &c., £319 19s.; debentures in Holmfield estate, estimated value, £37 10s.; book debts, £283 19s. 7d. Total, £1,679 11s. 6d; less preferential claims, £10; total net assets, £1,669 11s. 6d., showing a deficiency of £277 2s. 1d. The position of the firm had been brought about, it was stated, through losses on contracts. It was decided that the business be handed over to an inspectorship for the benefit of creditors, with Mr. J. Norman Lister, accountant, as trustee, and three of the principal creditors as a committee of inspection.

Certainly, by adjusting the excitation of the various

tubular form, the same arrangement of a central rod, serving

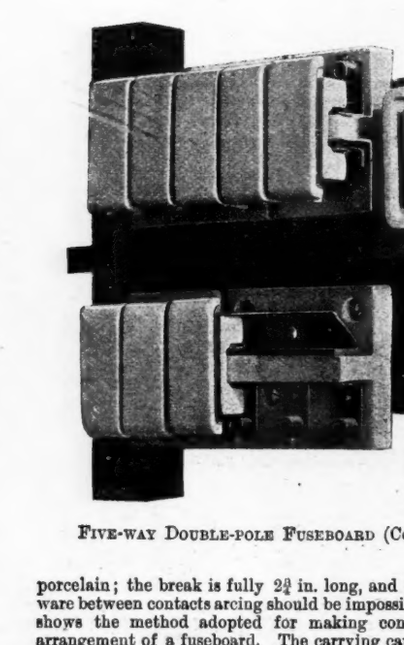
Electrical Wares Exported.

Week Ending May 15th, 1900.		Week ending May 14th, 1901.	
Adelaide	Value £76	Adelaide	Value £47
Amsterdam	160	„ Teleg. wire	74
Auckland	35	Alexandria	152
Azores. Teleg. mat.	1,154	Amsterdam	30
Barcelona	26	Auckland	120
„ Teleg. wire	102	Bombay	19
Boca	230	„ Teleg. wire	83
„ Teleg. mat.	79	Brisbane. Teleg. cable	51
Bombay	505	Buenos Ayres	51
Borkum. Teleg. cable	21,200	„ Teleg. mat.	688
Buenos Ayres	103	„ Teleg. wire	800
„ Teleg. mat.	112	Cape Town	100
„ Te'eph. mat.	88	Christiania	45
Calcutta	843	„ Teleg. cable	22
Cape Town	39	Copenhagen. Teleg. wire	82
Colombo	27	Demerara. Teleg. apparatus	44
Demerara	41	Durban	1,918
Durban	322	Fiume	307
„ Teleg. mat.	101	Ghent	13
East London	82	Gibraltar	89
Fremantle	56	Gothenburg. Teleg. wire	14
Gibraltar	110	Halifax. Teleg. wire	20
Hamburg. Teleg. mat.	400	Hong Kong	3,340
Hong Kong	16	Kobe	172
Karachi	240	Kure. Teleg. cable	11,637
Kobe. Teleph. cable	745	Launceston	45
Malta	186	Liban	32
Mauritius. Teleg. mat.	63	Malta	46
Melbourne	136	Melbourne	888
Ostend	28	„ Teleg mat.	3,446
Otago	70	Montreal	24
Rangoon	352	N. Atlantic. 838 knots Teleg. cable	—
Rosario	52	Odessa	25
Stockholm. Teleg. mat.	88	Penang	9
Sydney	1,453	Perth	43
Wellington	400	Port Chalmers	235
Yokohama	3,730	Shanghai	98
„ Teleph. appts.	90	Singapore	171
Zanzibar	40	Sydney	1,582
		Trieste. Teleg. cable	1,928
		Wellington	527
		Yokohama	1,528
Total	£33,530	Total	£30,550

Foreign Goods Transhipped.

Perth Elecl. machinery. Value £369 |

High-Pressure Fuseboard.—We have received from Messrs. Moores, Farrell & Co., Manchester, a sample of their high-voltage fuseboard, which is certainly the smallest and neatest that has come before our notice. The fuse is practically enclosed in the



Five-way Double-pole Fuseboard (Cover Removed).

porcelain; the break is fully 2⅜ in. long, and with the solid chinaware between contacts arcing should be impossible. The illustration shows the method adopted for making contact, and the general arrangement of a fuseboard. The carrying capacity of the bus bar and contacts is ample, but it would be better if the nuts for securing the thimbles were heavier.

Electric Lighting Boards.—We are informed that the excellent electric lighting effects in the great "Cinderella" pantomime at the London Hippodrome, which were carried out in a successful manner on the "E.L.B." system, are now being repeated for various purposes in different parts of the country. Thus the entire Irish Section of the International Exhibition at Glasgow has been decorated by a scheme of garlands, interspersed with shamrocks provided by the Electric Lighting Boards Company, of Pall Mall. Again, we find a similar scheme of decorative illumination installed for the Café Chantant at the Crystal Palace, whilst the effects have also been used for decorative purposes on several occasions at the Grafton Galleries. The Hippodrome installation has, in fact, been quite a pioneer in the greater elaboration of electrical effects as now so easily obtainable on the E.L.B. system.

Bankruptcy Proceedings.—Notice of intended dividend is given in the case of J. E. Bunce, electric fittings manager, Halifax.

Under the failure of George Wm. de Tunzelmann, 1, Bush Lane, E.C., and 6, Penywern Road, Earl's Court, electrical engineer, a sitting of the London Bankruptcy Court was held last Wednesday, before Mr. Registrar Giffard, for the public examination of the debtor. The statement of affairs shows unsecured creditors, £4,767; partly secured creditors £4,430, no value, however, being placed on the securities; assets, consisting of bad book debts, £2,465, and various company shares, no realisable value being placed upon either item; and an estimated deficiency of £9,1 7. According to the observations of the Official Receiver in charge of the case, the debtor states that he was proprietor of the Electrical and General Engineering College and Experimental Works at Nos. 2 and 4, Penywern Road, Earl's Court, S.W. (which he fitted up at a cost of about £4,500, chiefly borrowed from a relative), from 1893 to June, 1899, when he sold the business to a limited company then formed to acquire it and having a nominal capital of £15,000, of which about £1,500 was subscribed. The sale consideration was £7,500, payable as to £400 in cash, as to £2,100 in second debentures, and as to the balance in deferred ordinary shares of the company, of which he was for a short time managing director, and subsequently, until January last, a director. He states that a few weeks ago possession of the company's assets was taken by a receiver, on behalf of a first debenture holder, and that the shareholders have recently passed a resolution that the company be wound up voluntarily; that he, in March, 1897, promoted a company (having a nominal capital of £40,000, of which about £3,500 was subscribed) for the purpose of acquiring from him two patents for electric welding apparatus; that the sale consideration was upwards of £20,000, payable as to £2,000 in cash (of which about £1,400 was paid by him for one of the patents assigned to the company), and as to the balance in fully-paid shares of the company; that he has since acted as a director and also as consulting engineer to the company, but that it is doing little or no business; and that since September, 1899, he has been in business as consulting engineer, and has had the use of a friend's office at Bush Lane House, Cannon Street, E.C. He attributes his insolvency mainly to losses and expenses incurred in connection with the Electric Welding Company, to loss sustained by the transfer of the Electrical College and works to the company first before referred to (owing to the shares and debentures received in part payment of the purchase money being valueless), to loss by sale of his furniture in December, 1899, by the holder of a bill of sale thereon, to interest on loans, and to bad debts. The following deficiency account, dating from January 1st, 1898, has been filed, viz.:—

Excess of assets over liabilities at that date, chiefly represented by value placed on shares in companies	£9,100	0	0
Profit in carrying on college from that date to June, 1899	1,000	0	0
Fees received as consulting engineer and for literary work	440	0	0
Salary received from Electrical College Company	160	0	0
Salary received from Electric Welding Company	150	0	0
Deficiency as per statement of affairs	9,197	0	3
	£20,047	0	3
Loss on transfer of college and works to company, represented by depreciation in the value of shares and debentures received in part payment of purchase money	£7,497	0	0
Depreciation in the value of shares received from the Electric Welding Company in part payment of purchase money	6,550	0	0
Do. do. of shares in same company purchased by bankrupt	300	0	0
Bad debts	771	18	6
Liability for dilapidations at No. 2, Penywern Road	250	0	0
Interest on loans and premiums on lapsed life policies	1,380	0	0
Loss by forced sale of household furniture and library	1,650	0	0
Depreciation in the value of shares in an advertising syndicate purchased by bankrupt	55	0	0
Law costs	50	0	0
Household and personal expenditure, including maintenance of invalid sister (to balance)	1,942	1	9
	£20,047	0	3

The bankrupt states that the books of account kept by him prior to June, 1899, were handed to the company first before referred to, and that he has not since kept any books. Of the unsecured liabilities, £2,672 represents money borrowed from a relative, £421 6s. lecturers' and tutors' fees, about £415 goods supplied for the purposes of the electrical college and works, £250 the before-mentioned dilapidations, and the balance mainly goods supplied for household and personal use. The creditors treated as partly secured are respectively stated to hold (*a*) against £4,000, money lent and interest, (1) 6,000 £1 (fully paid) shares in the Welding Company, (2) £1,100, second debenture bonds of the Electrical College Company, (3) 1,500 £1 (fully paid) shares in the same company, and (4) 50 £1 (fully paid) shares in an advertising syndicate; (*b*) against £130, money lent and interest, 1,000 £1 (fully paid) shares in the Welding Company; (*c*) against £130, goods supplied for personal use, 200 similar shares, and (*d*) against £170, cost of maintenance and treatment of invalid sister, 250 similar shares. None of the securities have any market value. The debts due to the estate include a sum of £1,650, arrears of salary due from the last-mentioned company to the bankrupt as consulting engineer. The debtor further stated in reply to Mr. E. L. Hough, official receiver, that he was in difficulties when he sold the college and works to the company, and that was the reason for the sale. The company also got into difficulties, with the result that a few weeks ago the first debenture holders who had a prior claim to witness (he holding only second debentures) entered into possession by means of a Receiver. He was strictly of opinion that had he confined his attention entirely to the College and works, he would now be in a good financial position and thoroughly solvent. He had been pressed by creditors since the end of 1898, and had been almost

large stones or other obstructions can enter it; mud, &c.,

trustee, and three of the principal creditors as a committee of inspection.

entirely dependent upon borrowed money to carry through the company's schemes in which he had been interested, and which had brought about his failure. The examination was ordered to be concluded. Appended is a list of the principal creditors, viz.:—

UNSECURED.

Army and Navy Gazette, Wellington Street, Strand	£50
Caplin, Mrs., Isleworth	2,672
Electrician Publishing Company, Salisbury Court, Fleet Street, E.C.	12
Engineering, Limited, Bedford Street, W.C.	19
Farmen & Sons, High Street, Kensington	130
Glover, W. T., & Co., Trafford Park, Manchester	40
Holland & Co., Earl's Court, S.W.	50
Holtzapffel & Co., Charing Cross	18
Highton & Co., Graham Street, City Road	51
Longmans & Co., Paternoster Row, E.C.	148
Lightning, Limited. Bream's Buildings, Fetter Lane, E.C.	30
Macmillan & Co., St. Martin's Street, W.C.	12
Imperial Insurance Company, Old Broad Street, E.C.	250
Roxby, R. B., Featherstone Buildings, W.C.	62

PARTLY SECURED.

Cree & Sons, Gray's Inn Square, W.C.	4,000
Hoyland & Co., Great St. Helens, E.C.	130
Slater's, Limited, Kensington	130

In connection with the sequestration of Messrs. Hiley & Orchar, electrical engineers, Dundee, Mr. Robert Orchar was examined before Sheriff Campbell Smith at Dundee on 8th inst. He stated that he believed his brother William Orchar had gone to Hong Kong. In February, 1899, a bond and disposition in security on a property in Erskine Terrace was taken out by his brother, amounting to £700. He cashed the cheques, and received £600 as a gift. In April, 1899, he went abroad to Demerara to take over a business. Previous to going, his brother asked him to sign a deed for the £600, so that should he die abroad his brother would secure the money. The deed was purely a gift from his brother.

At Kilmarnock on May 22nd, John Murdoch, electrician, residing at 138, Glasgow Street, Ardrossan, is to be examined in the Sheriff Court House, County Buildings.

Mr. H. W. Freshwater, of Bristol, has been appointed trustee of the estate of G. J. Lloyd (G. H. Lloyd & Co., electrical and mechanical engineers, Bristol), whose present address is unknown.

Dissolutions and Liquidations. — The Smelting Corporation, Limited, whose electrical equipment was fully described in our issue of September 14th, 1900, is winding up voluntarily, with Mr. J. Peters, of 8, Eastcheap, E.C., as liquidator.

The Kerbey Bowen Electric Syndicate is winding up voluntarily. Mr. W. Roden, 72, Coleman Street, E.C., is liquidator.

The creditors of the Commercial Telegraph Construction Company should send particulars of their debts, &c., to Mr. C. Quennell, 7, Angel Court, Throgmorton Street, E.C., by June 30th.

Accumulator Works.—We read in the *Times* that at the Thames Police Court on Tuesday the Electric Power Storage Company, Limited, West Ferry Road, Millwall, were summoned for failing to carry out special rules for electric accumulator works by not seeing that the gloves used in the occupation of rubbing were constantly inspected and renewed when defective. There was also a second summons against the same company for failing to limewash the pasting shop and other parts of the factory within 14 months of the date of the last limewashing. Mr. C. C. Hoare, inspector of factories, prosecuted, and Mr. Charles Mathews, barrister, appeared for the company. Mr. Hoare, in opening the case and dealing with the first summons, said that under the Factory and Workshops Act of 1891 the Secretary of State had power to order special rules to be adopted in works of that nature, and electric accumulator works were subject to those rules, which were accepted by the defendants. On April 24th the workpeople were found to have certain gloves in use that were defective, some being badly so. Pasters, who used lead paste to put in their work, required to have the gloves in order that paste loaded with lead should be kept off their hands. Not less than one-third of the gloves in use were found to be defective, while one-half were not satisfactory. Mr. Mathews, on behalf of the directors, admitted the facts, and said that his clients were not cognisant of the state of affairs until the visit of the inspector. The office of the company was in Great Winchester Street, City, and the works in the West Ferry Road. The directors placed four men in control of the latter place. It was their duty to see that all matters of detail were properly carried out. So far as the supply of gloves was concerned, it could not be said that it was defective, for in March 20 pairs of gloves were issued to 25 men, and in April 18 pairs were issued to 18 men. Mr. Hoare remarked that the gloves only lasted a fortnight, and he could produce evidence that there was no constant inspection. Mr. Mathews said that the company would also plead "Guilty" to the second summons. On the first summons Mr. Mead inflicted a penalty of £4 10s. and 26s. costs, and on the second one £4 and 4s. costs.

Car Fenders.—The *Street Railway Journal* intimates that the Consolidated Car Fender Company, of New York, has established an agency for France, Italy, and Spain, and will push the fenders there. Sixty complete equipments are to be supplied for Colombo, Ceylon.

Catalogues and Lists.—The 1901 edition of the General Electric Company's catalogue of electric light supplies, switches, switchboards, cut-outs, lampholders, and incandescent lamps is before us. It is fully illustrated and priced, and will no doubt be serviceable to many electrical traders in London and the provinces. The eighth edition of their catalogue of fire alarms, electric clocks, telephones, and accessories is also issued, and will have an equally large demand.

Messrs. Hands, Limited, of Garlick Hill, E.C., have recently published a new fittings catalogue. There is a large variety of fittings for interior lighting, some simple, and some more elaborately artistic in design. Prices of the different designs of brackets, electroliers, pendants, standards, and so forth are given, and the illustrations are neatly set out.

Mr. H. Hodgson Wright, of Halifax, sends us a list of his latest improved C.C. enclosed motors. The improvements include making the end covers in two parts, so as to make the brush gear more accessible. The fans on the armature shafts have been re-designed, and the outputs have been increased. The list before us gives tabulated figures of the prices, weights, and several other details. Mr. Wright has appointed Mr. A. J. Hollington, of 37, Wallbrook, E.C., as his London agent for the sale of these motors, and also switches and switchboards.

Circular No. 1,047 of the British Westinghouse Company describes their standard railway switchboards.

The General Electric Company, Limited, have issued a new list of electric fire alarms and fire brigade calls, also one in which they describe Wood's patent swivel trolley head, frogs, crossings, and movable points, also an improved trolley standard for cars with top seats. This standard has been designed with a compensating lever, which carries the pole, and has been found necessary to meet the requirements of overhead lines where a number of railway bridges or viaducts have to be passed under, and where the wires are rigidly fixed. The arrangement is claimed to save 25 per cent. in the trolley wheels. Ordinary American type frogs and crossings are also listed and stocked.

A price list of ammeters and voltmeters, recorders, &c., with illustrations and descriptive notes, has been issued by Mr. James Pitkin, of Red Lion Street, E.C.

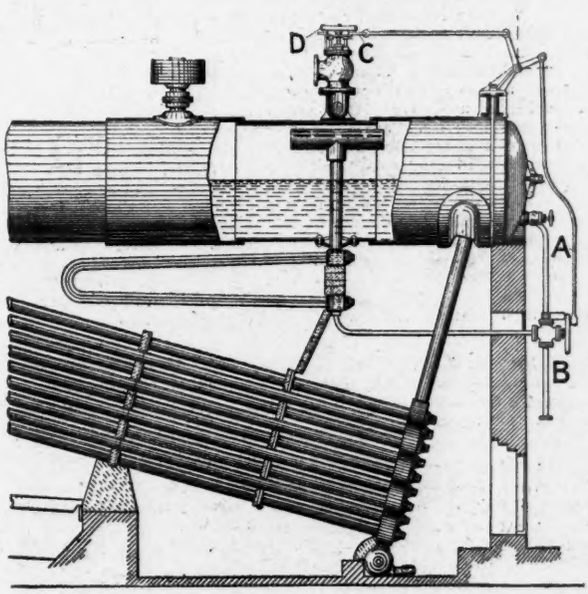
An excellent illustrated catalogue of telephones and telephone accessories, has been issued by the Berliner Telephone Manufacturing Company, Limited, of Queen Victoria Street, E.C. Various patterns of receivers and transmitters are shown, several kinds of battery ringing telephone sets, table and magneto wall sets, also telephones for mines, damp places and railway purposes. Some handsome desk and magneto inter-communication sets are included, also various portable instruments and numerous sundries for accessorial purposes. The many diagrams of connections which are given, cannot fail to be of service to those who are engaged in telephone fitting and planning.

Some good "points" for tramway engineers and managers, are to be found illustrated in the catalogue just published by the Steel Casting Company, of South Bank, near Middlesbrough. The company manufactures crucible cast-steel points and crossings, drain boxes, car wheels, brake blocks, pole equipment castings, manholes and so on.

Mr. G. C. Thiriet, of Myddelton Square, E.C., sends us a list of Bouhoulle's poor gas producers for which he is representative in this country.

The Pulsometer Engineering Company is showing how satisfactorily its steam pumps are working, by circulating a little pamphlet in which are extracted 100 new appreciations which have been received from users.

Interlocking Gear for Superheater Valves.—When we described and illustrated the superheater manufactured by Messrs. Babcock & Wilcox, in our issue of March 30th, 1900, we said:—"Before opening the superheater stop valve, care must be taken to drain the tubes; otherwise large quantities of water would be propelled into the steam pipes, probably entailing serious con-



sequences—especially if the boiler is being coupled with others already at work. To guard against this danger, a warning plate is fixed on the hand wheel of the stop valve; this, however, seems to us to be insufficient, as in a case of emergency even a careful

has, in fact, been quite a pioneer in the greater elaboration of electrical effects as now so easily obtainable on the E.L.B. system.

pressed by creditors since the end of 1898, and had been almost

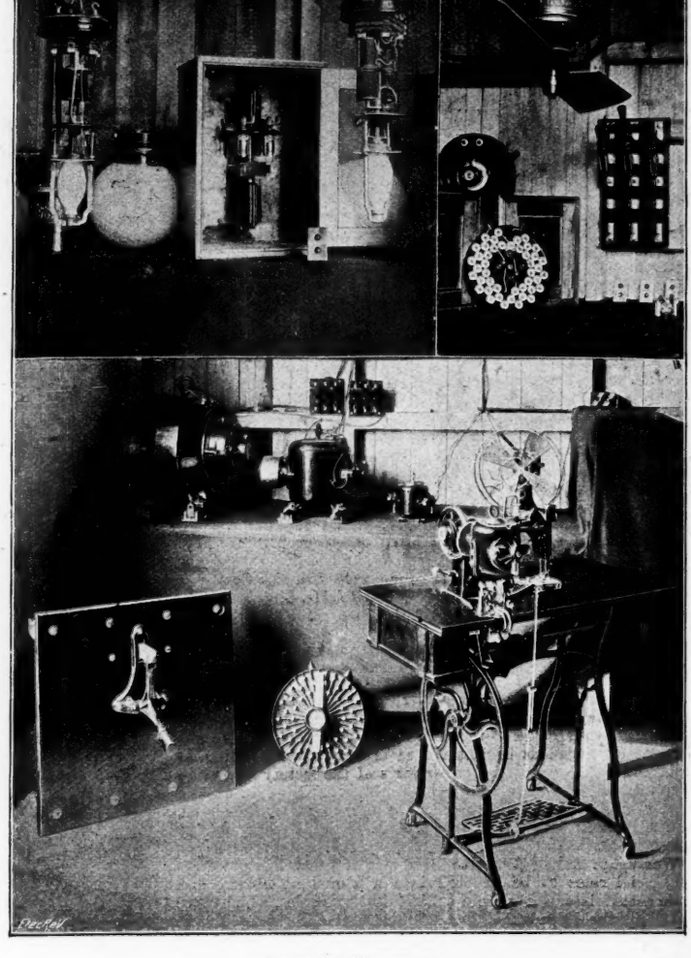
attendant is apt to get flurried. We should like to see an interlocking arrangement adopted, which would render it impossible to open the stop valve before draining the superheater." As happens in so many cases, it was not until serious trouble, of the kind which we foretold, had actually occurred that steps were taken to prevent its recurrence. The interlocking gear shown in the illustration, appearing on the previous page, is now being introduced by Messrs. Lovell & Co., of 56, Chancery Lane, and is already meeting with the approval of station engineers. Although the apparatus is shown applied to a Babcock boiler, it can be adapted to others of similar type. The flooding and draining cock can only be opened when the main stop valve, D, is closed, and whenever the former is open, whether for flooding or draining, the main stop valve is locked in its closed position. This is accomplished by means of the locking bar, C, actuated by the rod, A, which is controlled by the hand wheel, B, of the flooding cock. Thus it is made impossible for the water to be driven into the steam pipes through carelessness. Central station engineers will without doubt be interested in this device.

American Novelties.—Some interesting and novel devices for electrical purposes are being introduced into this country by Mr. J. B. Cowen, who has opened showrooms on behalf of the General Incandescent Arc Light Company, the Paragon Fan and Motor Company, and the Chicago Rheostat Company, at St. Alban's Place, Regent Street. Of the apparatus shown in the adjoining illustration, perhaps the most interesting is the sewing machine motor. This is arranged so as to clamp on the table of any ordinary machine. The motor is mounted on a pivot, and is connected by an adjustable rod with the treadle, so that it can be tilted by means of the foot. A leather-faced friction wheel, fixed on the armature shaft, bears against the fly-wheel of the machine, at right-angles to the pivot, so that the speed at which the machine is driven can be varied, by merely depressing the treadle, from rest up to full speed, the motor running at its normal speed all the time. The motor takes 65 watts when doing 1,600 stitches per minute, and 85 watts for 2,000 stitches. Behind the sewing machine may be seen a number of partially enclosed motors, which are standardised from $\frac{1}{20}$ to $7\frac{1}{2}$ H.P., and are designed to carry an *average* load equal to the rated output, provided that the maximum does not exceed 100 per cent. overload, with a temperature rise not exceeding 42° C. in the smallest sizes, and 32° C. in the largest.

Beside the sewing machine a dynamo field rheostat is shown, the back view of which is seen in the right-hand view above; in this device all the resistance coils are wound on separate bobbins and enamelled. Motor starting and other rheostats are also dealt in, and a large ceiling fan is shown in the figure.

Enclosed A.C. arc lamps for constant pressure and constant current circuits are shown in the upper view; these are provided with reactance coils and automatic cut-outs, and take about 80 volts. Constant current regulators are used for series lighting.

A neat push-button switch with positive action, passing up to 10 amperes, is shown on the upper view, together with an automatic switch which can be controlled from a distance, and which has a very powerful and certain action. Automatic circuit breakers, with carbon break and self-cleaning face contacts, are made for ordinary pressures, and an oil-break automatic circuit-breaker for use on high pressure systems, capable of breaking up to 200 amperes at 6,600 volts is shown. A variety of blade switches, quick-break and otherwise, and of incandescent lamps, &c., completes the exhibit.



AMERICAN NOVELTIES.

Complimentary Dinner.—Last week the Harrogate Corporation officials gave a dinner to Mr. G. F. A. Norman, of the electricity department, on his return from South Africa, where he has been serving as a volunteer.

Fire Prevention.—The executive of the British Fire Prevention Committee announce that the opening of their new testing station at Westbourne Lodge, Bayswater, will take place on Wednesday, 22nd inst., when testing operations will be resumed, and the issue of the Committee's reports will again be regularly proceeded with.

Fynn's Patent.—We are informed that the objection raised by Elektricitäts A. G. vorm W. Lahmeyer & Co., of Frankfurt, to the latest application by Mr. Fynn (of Rosling, Appleby and Fynn, Limited) for a German patent in respect to "improvements in windings of direct-current dynamos and motors," has been rejected by the German Patent Office.

The Galloway Engine.—A great deal of interest was created at the meeting of the Iron and Steel Institute last week by a paper entitled "A Comparison between American and British Rolling Mill Practice," read by Mr. William Garrett, the well-known rolling mill expert, of Cleveland, Ohio. The following extract is well worth quoting, and it is particularly interesting to note that the record breaking of the Americans should be obtained with the assistance of engines built in England. Messrs. Galloways certainly are to be congratulated upon the great compliment which has been paid to their engine:—"I may here say that the blooming mill, holding the world's record for the production of 4-in. billets per 24 hours—having produced 1,260 gross tons in that time at the plant of the Lorain Steel Company, Lorain, Ohio, from an 18-in. by 20-in. ingot, weighing 5,500 lbs.—is driven by a Galloway engine, and, in justice to the English engine builder, I may add that no engines in the United States give better satisfaction than the three Galloway engines at the plant of the Lorain Steel Company."

The Institution of Junior Engineers.—The sixth and concluding lecture of the course on "Works Management" was delivered by Mr. A. H. Barker, Wh. Sc., B.A., B.Sc., at the Westminster Palace Hotel on April 25th.

Lamp Works.—The Hammersmith Electric Lighting Committee paid a visit to the Robertson electric lamps works at Brook Green last week, making an examination of the premises and watching the various manufacturing processes, afterwards being entertained to tea.

Parliamentary Bills.—A financial contemporary quotes from the Board of Trade's customary sessional return the total number of Bills deposited for the present term of Parliament relating to railways, canals and tramways, and electricity, gas and water undertakings. Altogether there are 190, representing £88,738,900, as compared with 213, representing £94,534,200 last year. The number of measures concerning electricity is 11, and the proposed capital amounts to £12,549,300. In spite of the competition of electricity there are 43 Bills for gas supply, with a combined capital of £7,877,300. Tramway Bills number 36, and stand

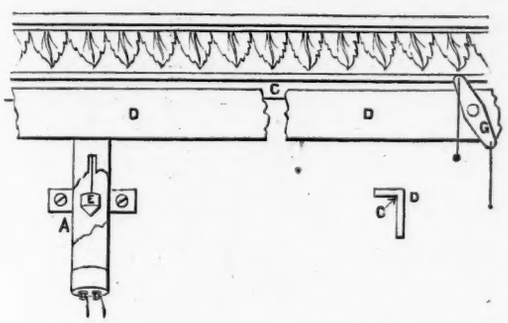
for £4,433,500. In addition to these measures there are 166 applications, requiring £4,101,500, for provisional orders, of which 108, taking £1,994,600, are for electric lighting.

The Cleveland and Durham Electric Power Bill was ordered for third reading in the Commons on 13th inst.

Railway Labels.—Mr. A. A. James, of West Bromwich, sends us a specimen of his patent tally, or label, which has been introduced with a view to meeting the requirements of the railway carriers, companies and manufacturers who wish to consign goods "under mark." Their adoption is said to prevent loss and delay in transit.

West Ham Electrical Exhibition.—At the Electrical Exhibition which will be opened on the 20th of this month at the Town Hall, Stratford, and which the Corporation of West Ham is organising, there will be an interesting demonstration of the manufacture of Robertson incandescent lamps by operators from the General Electric Company's works. We understand that this firm has also been asked by the Corporation to lend a large quantity of apparatus showing the various applications of electricity to everyday life. The list of the articles includes telephones, motors, operating sewing machines and fans, &c.; arc lamps for interior and exterior use, and also for stage purposes; electric cooking apparatus, irons, cigar lighters, radiators, and a great many other things. In addition to the exhibits there will be lectures given at the back of the Hall by an expert, on wireless telegraphy, X rays, Tesla effects, and other interesting subjects, with apparatus also lent by the General Electric Company, Limited. A notice relating to the exhibition, which opens on Monday next, appears in our business pages today.

May-Oatway Fire Detector and Indicator.—Since we described this system a year ago (May 4th, 1900), it has been modified and improved. It will be remembered that the essential feature of the system consists of a long taut copper wire, suspended horizontally along the wall of the room, and carrying a plug at the centre in a box, A. When the temperature of the air is unduly raised, the wire expands and sags, allowing the plug, E, to close an electric bell and indicator circuit. The wire, C, is now suspended from and protected by a metal guard D, as shown in the figure. Besides these functions, the guard acts as a temperature compensator, for while it expands and contracts with slow changes of temperature, keeping



the wire always at practically the same tension, a rapid rise of temperature affects the wire long before the guard responds to it. Thus the system automatically adapts itself to normal variations of temperature without losing its sensibility for abnormal variations. The lever G provides a means of testing the condition of the apparatus at any time. The interesting system of code signals automatically transmitted direct to the fire stations, which we outlined in our previous article, and of indicators which show at once the exact seat and extent of the danger, form important adjuncts to the detector apparatus—which, by the way, originated in New Zealand, and is largely used there. Sir E. M. Shaw is chairman of the new company, whose formation we announced last week, while Mr. G. H. Oatway is managing director, and Sir W. H. Preece consulting electrical engineer. We are informed that the company is preparing to establish agencies in all important British cities.

ELECTRIC LIGHT AND POWER NOTES.

Alderley and Wilmslow.—At the sixth annual meeting of the shareholders of the E.L. company, held last week, the secretary, Mr. W. E. Rowcliffe, presented the directors' report for the year ended December 31st, 1901, from which it appeared that the prospects of the company had considerably improved. The income was about double that of the preceding year, with only a slight increase in the working expenses. The number of lamps in the district is 3,045.

Ashford.—The Council last week confirmed the minutes of the Lighting Committee to instruct Mr. Thos. Hesketh to advise the Council in connection with the carrying out of their provisional order.

Bolton.—The past year's accounts of the Electricity Department of the Corporation show an expenditure of £13,549 (against £6,196 last year), of which £3,036 is represented by wages, and £7,751 by fuel; whilst the income figures at £24,103 (against £12,098 last year), leaving a balance of £10,554. The sale of electricity by meter has produced £12,444, and to the tramways £10,107. The capital expenditure has increased to £145,125, whilst the units generated were 2,937,171. The number of consumers has increased to 888, and the number of 8-C.P. lamps supplied to 74,395, whilst the price per unit charged has decreased to 2·22d. The gross surplus amount to £10,554, interest on loans standing at £3,815; the sum of £5,881 has been placed to depreciation account, and £857 has been allocated to relief of rates.

Canterbury.—The electric lighting accounts show that there are 250 consumers, as compared with 195 last year. The revenue account shows a gross surplus of £1,886, against £1,913 last year; of this, after paying interest and sinking fund charges, there remains £13 10s. 5d., as against £406 last year. The increased price of coal represented at least £350 extra, while other extraordinary expenses brought up the total of the extra cost to £550.

Colchester.—The electric light and power enterprise shows a net surplus for the year of upwards of £660.

Corea.—A Japanese syndicate has formed a company with the title Fusan-Dento Kaisha, and with a capital of 50,000 yen to establish and work a central electric lighting station in the Port of Fusan, Corea.

Darwen.—The loss in the electricity department during the year ending March 31st was £486, against £870 in the previous year; there has been a loss of £604 in the tramways department, against a profit. The energy sold during the year was 266,000 units, against 60,000 the previous year. It was stated at the meeting of the T.C. last week that altogether too much fuel was being used, compared with the effects produced. The average selling price had been reduced to 2¾d., against 4¾d. The tramway accounts showed expenses 7·5d, sinking fund and interest 3·86d., per car mile.

Dorking.—The U.D.C. has finally agreed with the West London and Provincial Electric Supply Company, Limited, for the transfer of the Council's prov. order. The Council reserves the right to repurchase the undertaking at cost price, plus such a sum as may be needed to make up a total dividend of 7½ per cent. on the capital expended.

East and West Molesey.—A member of the U.D.C. has given notice of motion to apply for a prov. order for lighting the district, with a view to transfer it to the London United Tramways, Limited.

Eastbourne.—The action of the Inland Revenue authorities with reference to the purchase of the electric lighting works by the T.C. has raised an interesting question. The Revenue claimed stamp duty upon the whole of the £88,635 which the Corporation paid for the undertaking, amounting to £443. The Council held that they were exempt from duty (amounting to about £200) upon the goods, wares and merchandise, which were estimated at £37,929, and in support of their contention urged that in 1897 the Inland Revenue exempted the neighbouring Corporation of Hastings from stamp duty upon the goods, &c., of a similar undertaking They also contended that the law had not since been altered, but that the revenue authorities had changed their view of the construction to be put upon the statutes. The case was heard on Friday last by Mr. Justice Kennedy and Mr. Justice Phillimore, the Attorney-General appearing for the Inland Revenue, and Mr. Ritchie Macoun and Mr. Beaufort Moore for the Town Council. After hearing the legal arguments, their Lordships gave judgment for the Crown, with costs.

Golbourne.—The South Lancashire Tramways Company wants to undertake the supply of electricity to the D.C. for the lighting of the district.

Jarrow.—Messrs. Palmers' Shipbuilding and Iron Company, of Jarrow, have just completed a large electrical installation in their works. A three-phase alternating current system at 440 volts has been adopted. The current is generated in a central power station containing two complete sets of plant, each having a generator of 750 KW. Two sets of vertical triple expansion marine type engines serve as prime motors. The generators are driven directly with the fly-wheel between them and the engine at about 164 revolutions per minute. Steam will be supplied by four Lancashire boilers worked by induced draught, and fitted with economisers. The plant is understood to be the most powerful of its kind that has, so far, been adopted in this country by a manufacturing concern. The electrical part of the work has been carried out by Messrs. Clarke, Chapman & Co. and the Westinghouse Company.

Java.—A company has lately been formed at Solo, Java, with a capital of 450,000k, and with the title the Solo Electriciteits Maatschappij, to establish and work a central station in the town for private and public electric lighting purposes.

Kimberley.—The contractors, Messrs. Reunert & Lenz, handed over the electric lighting plant to the Borough Council on 12th ult., their six months' guarantee having been satisfactorily accomplished. The borough electrical engineer, Mr. C. G. Vines, contemplates extensions at an early date.

King's Lynn.—The Corporation has decided to reduce the charges for energy for lighting purposes. Instead of a general charge of 5d. per unit for all energy consumed, during the months of May, June, July and August, 3d., and for the remaining eight months 5d. per unit will be charged; for each winter quarter, after 10 units per 8-C.P. lamp have been used, 3d. per unit.

Leeds.—The Leeds Industrial Co-operative Society have appointed Mr. E. Wilks chief engineer to equip all their factories with electric light and power, and to arrange the lighting of all their stores—85 in number. Mr. Wilks, who was formerly engineer to the Brighouse Corporation, was chosen out of a list of 300 candidates.

Leyton.—The U.D.C. has received the sanction of the L.G.B. to a loan of £5,000 for electric lighting.

London.—CITY.—In his annual report to the Corporation, says the *City Press*, the electrical engineer of the City (Mr. A. A. Voysey) points out that under the City of London Electric Lighting Act the Corporation is the first local authority which has acquired powers to purchase generating works and mains situated outside the district under its jurisdiction. The number of consumers supplied by the City of London Electric Lighting Company last year was 9,855, compared with 8,738 in 1899. Ten meters of the Aron type were submitted to the electrical engineer for certification during the year. Eight of them were found to be sufficiently correct, while one of them was over-registering, and another under-registering. Eighteen Thomson meters, the accuracy of which was disputed by consumers, were also submitted to him, and 10 of them were sufficiently correct. Four were over-registering, the mean error being 6·3 per cent., and one was under-registering the consumption by 3·3 per cent. The remaining three meters had apparently become faulty during their usé in such a manner as to tend to make them under-register the consumption. The undertakers have agreed in principle to an arrangement under which all the testing of meters is to be done in future at the Guildhall at their expense. Up to the beginning of the year about 27 miles of mains had been laid by the Charing Cross and Strand Electricity Supply Corporation in streets in the City, and the equivalent of 3,427 8-C.P. lamps was connected with those mains. The police reported during last year 817 lamp failures, as against 562 in the previous 12 months, whilst the penalties inflicted upon the Supply Company amounted to £171 3s., as against £173 6s. 3d. in 1899. The number of lamp failures last year is very large, owing to the momentary extinction of a great number of lamps, but if the time of extinction is taken into account, the electric lighting last year shows an improvement on previous years in the continuity of the lighting. The electrical engineer concludes his report in the following terms:—"Once again I regret to have to record that the question of lighting the side streets has been delayed by litigation as to the agreements for public lighting. Until the year 1899 the litigation was directed to determine the meaning of the agreements, and that litigation was interrupted before it was completed by the litigation as to the validity of the agreements. The delay in the determination of the legal relations of the Corporation and the City of London Electric Lighting Company with regard to electric lighting is to be regretted, not only because it has postponed the improvement in the lighting of the side streets, but also because it has prevented the general reconsideration of the public lighting question, which has, in my opinion, been for some time desirable."

Malvern.—The D.C. has resolved to obtain borrowing powers for £3,000 and £14,000 for a destructor and an electricity works respectively.

Manchester.—A L.G.B. inquiry was held last week by Mr. H. P. Boulnois, M.I.C.E., into an application of the Corporation to borrow £810,000 in connection with the supply of electricity. It was stated that the Corporation had already made arrangements with Levenshulme, Heaton Norris, Moss Side, Withington, Droylsden and Audenshaw, and they had decided to work the tramway system in the city, part of Salford, Stretford, Middleton, part of Stockport, Denton, Gorton and Failsworth, in addition to the places named. When these routes were fully constructed there would be 150 miles of single tramlines. The total amount authorised to be borrowed by the electricity department up to the end of last March was £884,011, and the amount expended on capital account to the same date was £867,322. It is proposed to light all the main streets through which the electric trams will run with arc lamps at a cost of £75,000.

An important discussion took place in the City Council on Wednesday, when the estimate of the Electricity Committee, which showed a loss of about £5,000, was passed. It was shown that the supply to outside townships had so far resulted in considerable loss, £60,000 having been spent for a return of £2,480.

Middlesbrough.—The E.L. Committee is recommending the T.C. to obtain borrowing powers for £34,000 for electric power purposes, and to accept the tender of Messrs. Witting Bros., out of 50 tenders for generating plant, at £3,564.

New Malden.—An offer has been made to the U.D.C. by Mr. F. J. Warden-Stevens, on behalf of a company not named, to supply the district with electricity on a 14 years' lease, providing the Council obtains a prov. order and the necessary loan. It was decided to ask for further details.

Pokesdown.—The U.D.C. wants the Bournemouth Corporation to apply to the B. of T. for an electric lighting prov. order for this district.

Portsmouth.—The E.L. Committee of the T.C. reports a deficit of £1,000 on the year's working, due to the heavy expenditure on coal.

Royton and Crompton.—The Lancashire County Council has petitioned against the electric lighting prov. orders of Royton and Crompton D.Cs.

Shrewsbury.—The report of the Lighting Committee stated that the energy sold had increased 76 per cent. in 12 months, and that preparations were being made for the fixing of the new engine and dynamo. To meet the increasing demand the Committee recommended a further loan of £16,526, as it was absolutely necessary that additional cables should be laid in the town. An increase of £50 a year was recommended in the salary of the electrical engineer. The report was adopted.

Spain.—Tenders have just been invited for the concession for the electric lighting of the town of Ondara (province of Alecante) during a period of 15 years.

Wadsley.—The Asylums Committee of the West Riding County Council have instructed their surveyor to report upon a complete scheme of electric lighting for the Wadsley Asylum.

Walker.—The Council has obtained sanction to borrow £18,559 for electric lighting and £14,700 for a refuse destructor.

Woolwich.—The T.C. has resolved to offer the Woolwich District Electric Light Company £80,000 for their works, the Council to take the profits of the undertaking as from December 31st, 1900, and control the company's capital expenditure from that date, paying the company in return 4 per cent. interest on the £80,000 as from that date until the completion of the purchase. The Electricity Committee resolved that the tender of Messrs. Smith & Son, South Norwood, of £40,574, be accepted for buildings in connection with the electricity works and dust destructor. The Committee fixed the charge for motive power, heating, &c., at 2d. per unit.

Wolverhampton.—In the annual report of the Chamber of Commerce, it is stated that the electrical trade has been well supplied with orders during the past year. The local works are fully occupied, and the prospects for the present year are good.

ELECTRIC TRACTION NOTES.

American Street Tramways.—*American Street Railway Investments*, which is a supplement to the *Street Railway Journal*, is published yearly, and is known as the Street Railway "Red Book," it being strongly bound in covers of that colour. The issue for 1901 has just been published, and its contents have been brought up to date. The reports of all the street railway companies in the United States and Canada are included, in many cases giving particulars of their financial position, and details of their plant and equipment, together with names of officials. Official comparisons of operating receipts and expenses for the past four or five years are included for a number of the systems. There are many maps accompanying the letterpress, and these show the different systems used, whether conduit, trolley, cable, or horse, by different colours. The price of the book is $5, and we have no doubt that it will be well worth that sum to those who wish to have in their possession a complete statement of the traction systems of America, whether their interest be of an engineering or a financial kind.

Birmingham.—The Bristol road route, upon which battery traction was employed for so many years, is now run by overhead trolley, the formal opening being performed on 13th inst. in the presence of members of the Corporate authority, who met upon the invitation of the City of Birmingham Tramways Company, and were afterwards entertained to luncheon.

Bolton.—The accounts of a very satisfactory year's working of the electric tramways undertaking have just been issued by the Corporation. The total income for the year ending March 31st in traffic receipts has been £69,147, and the following are the items of expenditure:—Maintenance of line, &c., £3,094; rents, rates, &c., £2,143; interest account, £6,623; traffic expenses account, £735; management account, £1,616; maintenance of equipment, £680, and of cars, £3,011; miscellaneous expenses account, £634; charge for electric power, £10,107; compensations, &c., account, £508; wages of drivers, conductors, &c., £13,412; wages of cleaners, labourers, &c., £4,405; track (construction), £8,227; land, buildings, &c., £2,6·4; electrical equipment, £2,454; cars, £2,760. The total liabilities are stated at £281,353, against which the tramlines are estimated to be worth £94,261; land, buildings and goodwill, £86,786; overhead equipment, £46,644; cars, £24,873. There is a cash balance of £25,798. The Committee have decided to devote £5,742 to the relief of rates.

Chatham.—The work connected with the Chatham and District Light Railways is to commence forthwith. Messrs. J. W. Nash & Son, architects, of Rochester, have received tenders for the erection of a car shed at Luton and the erection of a boundary wall for the site, which consists of about three acres. The lowest tender by Messrs. West Bros., £7,557, has been accepted.

Coseley.—The U.D.C. last week had before it a letter from the British Electric Traction Company, Limited, asking for permission to break up the roads under the control of the Coseley Council for the purpose of erecting trolley poles. It was decided to leave the matter in the hands of the surveyor.

East and West Molesey.—The U.D.C. has decided to petition against the Bill of the London United Tramways, Limited.

Glasgow.—Several preliminary runs have now been made with the 6,500-volt generating sets. Some minor accidents have occurred to the cars on the streets, but this was only to be expected when the increased rate of speed of the cars and other matters, such as the hurry to get electric service started before the Exhibition opened are taken into consideration. A new record in traffic receipts was created for the week ending May 4th, when £11,756 11s. 1d. was received. In regard to the horse auctions, we learn that "owing to circumstances which have arisen" the number offered for sale on Wednesday was considerably restricted, and yesterday's sale had to be cancelled altogether. It would be interesting to know what the "circumstances" are.

Greenock.—It is expected that by the middle of June the new electric car routes will be in working order. The system extends from Ashton to Port Glasgow. By an agreement between the company and the Corporation, ½d. fares are to be adopted on the 10th inst.

Isle of Thanet.—The *Kent Argus* understands that the Ramsgate Corporation have received a reply to their letter sent to the Electric (Light) Railway Company asking for an explanation of the recent accidents which have occurred along the line of route. The answer was considered unsatisfactory, and the Corporation have therefore decided to communicate with the Board of Trade.

Italy.—An electric rack railway has recently been inaugurated between Genoa and the suburb of Granarolo, and possesses a certain interest in being the first of its kind in Italy—funicular lines having been hitherto used under similar circumstances. The length of the line is 1,135 metres with a difference in level between the extreme points of 195½ metres. The gradients vary from 10 to 20·15 per cent.—their average being 17·15 per cent. It is a single line with a siding about midway, and is built with steel Vignoles rails of 21 kg. per metre. The rack is of the Riggerbach type and is placed in the centre of the permanent way. The carriages are automobile. On the axles are fixed two carrying wheels and a toothed wheel which engages the rack. Each carriage is furnished with two motors of 30 H.P. The current is continuous and at a tension of 500 volts. The current is collected by the trolley system. The motors serve as brakes for the downward journey; but the carriages are also provided with mechanical brakes. The line is at present worked by two carriages starting simultaneously from each end and accomplishing the journey in 14 minutes. The average speed in ascending is 5 kh., and in descending does not exceed 8 kh.

Johnstone (Renfrewshire).—At their meeting last night the Council congratulated Mr. Murphy on the passing through Committee stage of his Paisley District Tramways Order, and the hope was expressed that the tramways would soon be working.

Light Railways.—The Light Railway Commissioners have submitted the following orders to the B. of T. for confirmation:—Jarrow and South Shields, Mid-Anglian (Bury and Diss), Bath and District.

Liverpool.—The circumstances attending the death of a child named Wm. Henry Francis, two years of age, who was killed by an electric tramcar in Commercial Road, Liverpool, on Monday of last week, formed the subject of a lengthy inquiry before Mr. E. A. Gibson, deputy coroner, at Liverpool, on Thursday, May 9th. The evidence showed that the child left the footpath to cross the road as the electric car was approaching; that the car struck him, and that the lifeguard passed over him. On being picked up, the child was found to be dead. The driver and conductor of the car stated that it was travelling at the rate of about six miles an hour at the time. Mr. W. Pierce, deputy town clerk, who attended the inquest on behalf of the Corporation, stated that the Corporation were carrying on the tramways under their statutory powers, and were accordingly entitled to run their cars in the streets. For the purpose they provided the best appliances and employed competent men and did everything possible to prevent accidents of the kind occurring. Mr. C. R. Bellamy, manager of the Liverpool tramways, who also appeared on behalf of the Corporation, said that the car which had caused the accident was fitted with the standard pattern English lifeguard. The clearance between the guard and the surface of the road was only 2½ in. There had been very few fatal accidents when that type of guard had been used. The attention of the authorities had been specially directed to lifeguards for the electric cars, and they were now experimenting in the matter. He rather favoured a guard which pushed an object clear of the track instead of one which picked the object up. From statistics which he had prepared, he was able to say that the average of fatalities caused by electric traction was one in 10 millions, whereas with horse traction the average was one in five millions. The Liverpool Corporation cars had carried over 100,000,000 passengers since electric traction commenced in the city. There had not been as many fatalities with the electric cars as there might have been with the horse cars if they had carried as many passengers as the electric cars had done. The number of children about the streets was a source of difficulty and danger. The Tramways Committee had been in communication with the school authorities with a view to warning children against the danger of playing in the streets. In submitting the case to the jury, the coroner recited the facts of the accident, and pointed out that apart from the question whether a good look-out was kept on the car, there was the question whether the appliances used on the cars as lifeguards were sufficient? The jury had heard what Mr. Bellamy had said, and he (the coroner) wished to emphasise the fact that with an enormous undertaking like the Liverpool electric tramways so few accidents had occurred. It was patent to everybody that at certain times in the day the streets were alive with children, which made it very trying to the drivers, not only of the electric cars, but of other vehicles. Some people of a nervous temperament had got the idea that the electric cars were a danger to the public, but, in his opinion, that was not so. As a matter of fact, there were fewer fatal accidents under the electric car system than under horse traction, but when accidents did take place with the electric cars, they were of a shocking character, and made it very desirable that something should be done, if possible, to prevent them. The jury returned a verdict of "Accidental Death," adding that the drivers of the cars should be more careful. The subject of lifeguards they left to Mr. Bellamy, in the hope that any improvement which could be made would be carried out.

Northwich.—The Earl of Jersey and Colonel Boughey, Light Railway Commissioners, who held an inquiry at Northwich into the application of Messrs. Brunner, Mond & Co., Holden, Hesketh, and others, to authorise the construction of a light railway from Northwich to Warrington and a westerly extension through Barnton, &c., the proposed scheme being roughly estimated to cost £120,000, decided to recommend that subject to the applicants paying £280 towards the erection of a swing bridge, as agreed with the Weaver Trustees, an order authorising the construction of the railways should be made.

Oldham.—The certificate signifying that the Middleton Road route of the Oldham electric tramways is fit for public service has been received from the Board of Trade. An order has also been received sanctioning the use of the electrical power on the above lines.

Portsmouth.—Sir Frederick Bramwell, the arbitrator appointed in connection with the transfer of the local tramways from the Provincial Tramways Company to the Corporation, has made his award. The sum to be paid by the purchasers has been fixed at £185,633 and costs. The company's final claim was for £280,569 16s. 9d., and the Corporation estimated the amount to be paid as £150,000. The tramway company has already received £10,000 for the cars and horses, which brings the total up to £195,635. When to this are added the law and other costs, which are estimated at £12,000, the full amount will be brought to over £200,000. This sum is £25,000 more than the company offered to accept three years ago for the transfer of the entire undertaking, including omnibuses. The cost of the reconstruction for electrical purposes is £327,134, so that the initial cost to the town will be about £600,000.

Spain.—The horse tramways in the town of Malaga are to be converted into electric lines.

Sunderland.—The question of the tramways for the rural district around Sunderland, although making slow progress, is nevertheless not being overlooked. On Friday a deputation from the British Electric Power Company waited on the Tramways Committee of the Sunderland Corporation and asked for powers to run on the Corporation lines into the town. Mr. Balfour, the engineer of the company, and Mr. Alcock, the electrical engineer, were with the deputation. There was some discussion, and eventually the company were asked to put their ideas and wishes into writing.

Swindon.—The Corporation on Tuesday considered the report of Col. Yorke, Board of Trade inspector, with regard to his inspection of the routes selected for the proposed electric trams, and it was decided, subject to the arrangement of details, to accept the recommendations contained in the report. The chairman of the Tramways Committee, with the engineer (Mr. Lacey), and the solicitor, were instructed to interview the Board of Trade on the subject. The plans for the buildings included in the electric generating station have been approved by the Works and Plans Committee, and tenders for the erection of these buildings will be at once advertised for.

Wolverhampton.—An attempt was made at the T.C. meeting on Monday to upset the decision arrived at by the Council in committee last week in favour of the adoption of the Lorain system of surface traction on the new electric tramways. On the Mayor moving the confirmation of the resolution of the meeting of the Council in committee, the chairman moved the following amendment:—

That having regard to the divided opinion of the Tramway Committee upon the Lorain system, and in the absence of any report from the committee recommending the adoption of that system, or of any direct recommendation from the electrical engineer, or Mr. Rees, this Council cannot agree to the experiments proposed, or to the extra expenditure involved in the Lorain system, until it is directly recommended by further and independent experts; and that the matter be referred back to the committee in order that definite expert advice on the mechanical and commercial aspects of the system shall be obtained, a report of which shall be made to the Council at the earliest date possible.

The question was again discussed at considerable length, and finally the amendment was lost, 18 voting in its favour, and 25 against. The result, therefore, is that the experimental line on the Bilston Road is to be laid at once.

Preston.—On Thursday of last week the Preston Town Council adopted a report of the Tramways Sub-committee, and decided that the Council would work the tramways themselves Also that authority should be obtained for altering the gauge from 4 ft. to 4 ft. 8½ in.

TELEGRAPH AND TELEPHONE NOTES.

The Chi-Fu—Wei-Hai-Wei Cable.—A Parliamentary paper has just been issued (and is abstracted in the *Times*) giving the terms of the agreement made with the Eastern Extension Telegraph Company for the construction and working, on behalf of his Majesty's Government, of a submarine cable between Chi-Fu and Wei-Hai-Wei. A Treasury minute at the close of the paper summarises the agreement and the steps which led up to its conclusion. The need for telegraphic communication with Wei-Hai-Wei became apparent soon after its occupation, and as it became still more urgent in view of the events of last year, the Government approached the Eastern Extension Company in order to ascertain the terms on which it was prepared to connect Wei-Hai-Wei with the rest of its Chinese system. In the course of the negotiations the company intimated that it had been asked by the local Chinese Telegraph Administration to extend its cables to Chi-Fu and Ta-ku, and that, if this extension were made, communication with Wei-Hai-Wei could be effected by the laying of a comparatively short cable thence to Chi-Fu. The company offered to lay this cable for the payment of £16,000, and to work it, on behalf of his Majesty's Government, for a subsidy of £4,000 per annum, and asked in return for the support of the Government in the negotiations which it was carrying on with the Chinese Telegraph Administration. The terms offered by the company were accepted by the Government which requested the company to lay the new line as rapidly as possible. It was opened for working on September 5th last year.

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The *Times* reports that the reply of the Chancellor of the Exchequer was as follows:—"The figures mentioned by the hon. member appear to be approximately correct. The sum of £587,452 is made up of two items—namely, £288,502, the excess of expenditure over receipts, and £298,860, the interest on the capital raised for the purposes of the Telegraph Acts. I think the reason for this loss is that the public and their representatives in this House have preferred to get a return on the capital in the form of facilities for telegraphic communication rather than in the form of revenue, and that the best way to check the increasing deficiency in the telegraph account would be to discourage, at any rate to some extent, demands for expensive concessions which do not produce any corresponding increase of revenue.

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Landlines :—		
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Chinese cables—Tschifu-Shangeai ..	.. May 12, 1901 ..	..

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CONTRACTS OPEN AND CLOSED.

OPEN

Bermondsey.—May 21st. The Borough Council wants tenders for the wiring, fittings, &c., for the installation at the electricity works and stables. See "Official Notices" May 3rd.

Bradford.—The Bradford Corporation are about to advertise for material for the overhead equipment of the Manchester Road Tramway. They have decided to use Cooper's patent joint rails throughout this route.

Brazil.—July 8th. The Foreign Secretary has received a despatch from H.M. Consul-General at Rio de Janeiro, stating that tenders are invited by the Brazilian Government, to be received not later than July 8th, for the supply of electrical machinery for the hoisting and transporting of locomotives at the Engenho de Dentro Works. Some particulars may be examined at the Commercial Department of the Foreign Office.

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Exeter.—June 14th. The Council wants tenders for water-tube boilers, steam alternators, switchboards, coaling apparatus, tanks, &c. See "Official Notices" May 10th.

France.—May 23rd. The French Post and Telegraph authorities in Paris are inviting tenders until the 23rd inst. for the supply of four lots of telephone cable and 10 lots of magnetic calls. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

Glasgow.—June 10th. The Corporation wants tenders for electricity meters. See "Official Notices" to-day.

Hendon.—June 5th. The U.D.C. wants tenders for the wiring of the new Council offices. See "Official Notices" May 3rd.

Hull.—May 23rd. The E.L. Committee wants tenders for 12 D.C. street arc lamps, with posts, &c. See "Official Notices" May 10th.

Ipswich.—June 8th. The Corporation wants tenders for dryback marine type boilers 11 ft. 6 in. × 14 ft. long. See "Official Notices" to-day.

Kingstown.—May 30th. The U.D.C. wants tenders for boilers, pumps, piping, economiser, &c.; engines, generators, balancer, and booster; switchboards and instruments; battery; cables, street work, boxes, switch pillars; electric wiring of supply station; electricity meters, demand indicators, and main fuses; arc and incandescent lamps, &c. See "Official Notices" May 10th.

Long Eaton.—May 20th. The Council wants tenders for two Lancashire boilers, engines, dynamos, switchboard, &c. See "Official Notices" May 3rd.

Madrid.—June 1st. The Secretary of State for Foreign Affairs has received a despatch from H.M. Ambassador at Madrid stating that tenders are invited by the Spanish Postal and Telegraph Department for the supply of 30,000 zinc cylinders for the service of the Government telegraph stations. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office.

Maidstone.—May 30th. The E.L. Committee wants free wiring proposals. See "Official Notices" to-day.

Manchester.—May 18th. The Tramways Committee wants tenders for 5,000 tons of steel rails, 170 tons of fishplates, 110 tons of tie-bars, 35 tons of bolts and nuts, and 5,000 tramway poles. See "Official Notices" May 10th.

Manchester.—May 25th. The Tramways Committee wants tenders for track work, cross-over tracks, &c. See "Official Notices" to-day.

Motherwell.—May 18th. The E.L. Committee wants tenders for cast-iron lamp columns, arc lamps, switches, fittings, &c.

Plymouth.—May 18th. The Corporation wants tenders for overhead line construction. See "Official Notices" March 3rd.

Rochdale.—May 23rd. The Corporation wants tenders for copper rail bonds. See "Official Notices" May 10th.

Rotherham. — May 17th. The Corporation wants tenders for wiring the municipal buildings. T. H. Copnell, Town Clerk, Town Hall.

Stoke-upon-Trent.—May 22nd. The Guardians want tenders for electric motors for driving new laundry machinery, also for wiring certain buildings. See "Official Notices" to-day.

Sunderland. — May 31st. The Corporation wants tenders for coal bunker and overhead gantry for electricity works. See "Official Notices" to-day.

Tonbridge.—May 30th. The U.D.C. wants tenders for Lancashire boilers, two 50-KW. steam dynamos, condensing plant, crane, switchboard, battery, mains, arc and incandescent lighting, house meters, &c. See "Official Notices" April 12th.

Worksop.—May 29th. The U.D.C. wants tenders for the supply of 150 electricity meters. See "Official Notices" to-day.

CLOSED.

Aberdeen.—The T.C. has accepted a tender at £4,928 for the erection of buildings for the Ferryhill electricity works, and has placed a contract with Messrs. Babcock & Wilcox for six boilers for £10,175.

Ashton-under-Lyne.—The Corporation has given the contract for two 250-H.P. direct current generating sets to Messrs. Siemens Bros. & Co., Limited, at the sum of £3,260. The engines will be by Belliss. There were 50 tenders sent in.

Bradford.—The Corporation has accepted the offer of the British Insulated Wire Company, Limited, for the supply of lead-covered and armoured cable for lighting main extensions for £2,562. The Corporation has also accepted the tender of the Phœnix Dynamo Manufacturing Company to supply for the Bolton Road Electricity Works, a combined motor balancer and boosters and switch gear for £1,403 18s., and for the Valley Road Works a 100-KW. motor-generator and switch gear for £883 10s.

Bushey, Herts.—The order for three complete sets of direct-coupled Taunton dynamos and Belliss engines for the Royal Masonic Institution for Boys has been placed with the Newton Electrical Works, Limited, Taunton.

Cardiff.—Messrs. John Priest & Son, Limited, of Bristol, have secured the contract for electric tramway brackets.

Edinburgh.—Messrs. James Gray & Son, of Edinburgh, have obtained the contract—amounting to something like £10,000—for the electrical tubing and wiring of the new North British Railway Company's hotel in Princes Street.

Kingston-on-Thames.—In our list of tenders accepted by this Corporation in our issue of May 3rd, we stated that Messrs. Scarfe & Sons, Stalybridge, had secured the contract for an economiser. We are asked to state that the name of this firm is Messrs. Jas. Carter & Sons.

London.—Mr. Arthur Koppel, of Clement's Lane, E.C., has received from the Charing Cross and City Electric Company, Limited, an order for two sets of counter current jet condensing plants for 25,000 lbs. of exhaust steam per hour each; and six circular iron natural draught cooling towers, each for 75,000 gallons of water per hour (all Balcke's patents). These are for their new works at Stratford.

Sunderland.—The Corporation have been letting their annual contracts, which have included the following:—St. Helen's Cable Company for cables; Doulton & Co. for stoneware casings; Watson Gow & Co. for cast-iron pipes; Isdale & Farrow for wrought-iron pipes. Other tenders let in connection with extensions are:—Clayton & Co. for additional panels to tramway switchboards; D. King for arc lamp pillars; Crompton & Co. for arc lamps.

Wakefield.—The following tenders have been accepted by the E.L. Committee:—Messrs. W. H. Allen & Co., Bedford, surface condensing plant, £875; Messrs. Oliver & Co., Woolwich, 40 arc lamps, switches, and transformers, £588.

FORTHCOMING EVENTS.

Friday, May 17th.—Society of Arts. Howard lecture, by A. C. Eborall, "Polyphase Electric Working." Lecture IV.—The polyphase transmission line: overhead and underground work—The effects of capacity and inductance on the working of the system—The fundamental calculations of polyphase transmission systems and installations — The regulation of polyphase systems.

At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Closing business meeting, to be held in the Lecture Hall of the Literary and Philosophical Society, Westgate Road, Newcastle-upon-Tyne. The discussion on Mr. Edwin Griffith's paper on "Water-tube Boilers" will be resumed and closed. Mr. Edwin Griffith will reply.

Saturday, May 18th.—At 10 a.m. Institution of Electrical Engineers (Students' Section). Visit to the works of Messrs. Elliott Bros., Lewisham.

Monday, May 20th.—At 6 p.m. The Institution of Junior Engineers. Visit to the works of the Renewable Electric Lamp Company, Brunswick Place, City Road, N.

Wednesday, May 22nd.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham Section). The last meeting of the session will be held in the Physical Theatre, the University, Birmingham. Discussion on Mr. A. C. Eborall's paper, "Some Notes on Polyphase Sub-station Machinery."

Thursday, May 23rd.—At 3 p.m. Royal Institution. Prof. Dewar, F.R.S., will commence a series of three lectures on "The Chemistry of Carbon."

At 7.30 p.m. Institution of Electrical Engineers (Dublin Section). Annual general meeting, to be held at the Royal College of Science, Dublin. Paper by W. Tatlow, entitled "Note on the Arrangement of Accumulators in a Small Installation."

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Hull.—May 23rd. The E.L. Committee wants tenders for 12 D.C. street arc lamps, with posts, &c. See "Official Notices" May 10th.

Ipswich.—June 8th. The Corporation wants tenders for dryback marine type boilers 11 ft. 6 in. × 14 ft. long. See "Official Notices" to-day.

Kingstown.—May 30th. The U.D.C. wants tenders for boilers, pumps, piping, economiser, &c.; engines, generators, balancer, and booster; switchboards and instruments; battery; cables, street work, boxes, switch pillars; electric wiring of supply station; electricity meters, demand indicators, and main fuses; arc and incandescent lamps, &c. See "Official Notices" May 10th.

Long Eaton.—May 20th. The Council wants tenders for two Lancashire boilers, engines, dynamos, switchboard, &c. See "Official Notices" May 3rd.

Madrid.—June 1st. The Secretary of State for Foreign Affairs has received a despatch from H.M. Ambassador at Madrid stating that tenders are invited by the Spanish Postal and Telegraph Department for the supply of 30,000 zinc cylinders for the service of the Government telegraph stations. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office.

Maidstone.—May 30th. The E.L. Committee wants free wiring proposals. See "Official Notices" to-day.

Manchester.—May 18th. The Tramways Committee wants tenders for 5,000 tons of steel rails, 170 tons of fishplates, 110 tons of tie-bars, 35 tons of bolts and nuts, and 5,000 tramway poles. See "Official Notices" May 10th.

Manchester.—May 25th. The Tramways Committee wants tenders for track work, cross-over tracks, &c. See "Official Notices" to-day.

Motherwell.—May 18th. The E.L. Committee wants tenders for cast-iron lamp columns, arc lamps, switches, fittings, &c.

Plymouth.—May 18th. The Corporation wants tenders for overhead line construction. See "Official Notices" March 3rd.

Rochdale.—May 23rd. The Corporation wants tenders for copper rail bonds. See "Official Notices" May 10th.

Rotherham. — May 17th. The Corporation wants tenders for wiring the municipal buildings. T. H. Copnell, Town Clerk, Town Hall.

Stoke-upon-Trent.—May 22nd. The Guardians want tenders for electric motors for driving new laundry machinery, also for wiring certain buildings. See "Official Notices" to-day.

Sunderland. — May 31st. The Corporation wants tenders for coal bunker and overhead gantry for electricity works. See "Official Notices" to-day.

Tonbridge.—May 30th. The U.D.C. wants tenders for Lancashire boilers, two 50-KW. steam dynamos, condensing plant, crane, switchboard, battery, mains, arc and incandescent lighting, house meters, &c. See "Official Notices" April 12th.

Worksop.—May 29th. The U.D.C. wants tenders for the supply of 150 electricity meters. See "Official Notices" to-day.

CLOSED.

Aberdeen.—The T.C. has accepted a tender at £4,928 for the erection of buildings for the Ferryhill electricity works, and has placed a contract with Messrs. Babcock & Wilcox for six boilers for £10,175.

Ashton-under-Lyne.—The Corporation has given the contract for two 250-H.P. direct current generating sets to Messrs. Siemens Bros. & Co., Limited, at the sum of £3,260. The engines will be by Belliss. There were 50 tenders sent in.

Bradford.—The Corporation has accepted the offer of the British Insulated Wire Company, Limited, for the supply of lead-covered and armoured cable for lighting main extensions for £2,562. The Corporation has also accepted the tender of the Phœnix Dynamo Manufacturing Company to supply for the Bolton Road Electricity Works, a combined motor balancer and boosters and switch gear for £1,403 18s., and for the Valley Road Works a 100-KW. motor-generator and switch gear for £883 10s.

Bushey, Herts.—The order for three complete sets of direct-coupled Taunton dynamos and Belliss engines for the Royal Masonic Institution for Boys has been placed with the Newton Electrical Works, Limited, Taunton.

Cardiff.—Messrs. John Priest & Son, Limited, of Bristol, have secured the contract for electric tramway brackets.

Edinburgh.—Messrs. James Gray & Son, of Edinburgh, have obtained the contract—amounting to something like £10,000—for the electrical tubing and wiring of the new North British Railway Company's hotel in Princes Street.

Kingston-on-Thames.—In our list of tenders accepted by this Corporation in our issue of May 3rd, we stated that Messrs. Scarfe & Sons, Stalybridge, had secured the contract for an economiser. We are asked to state that the name of this firm is Messrs. Jas. Carter & Sons.

London.—Mr. Arthur Koppel, of Clement's Lane, E.C., has received from the Charing Cross and City Electric Company, Limited, an order for two sets of counter current jet condensing plants for 25,000 lbs. of exhaust steam per hour each; and six circular iron natural draught cooling towers, each for 75,000 gallons of water per hour (all Balcke's patents). These are for their new works at Stratford.

Sunderland.—The Corporation have been letting their annual contracts, which have included the following:—St. Helen's Cable Company for cables; Doulton & Co. for stoneware casings; Watson Gow & Co. for cast-iron pipes; Isdale & Farrow for wrought-iron pipes. Other tenders let in connection with extensions are:—Clayton & Co. for additional panels to tramway switchboards; D. King for arc lamp pillars; Crompton & Co. for arc lamps.

Wakefield.—The following tenders have been accepted by the E.L. Committee:—Messrs. W. H. Allen & Co., Bedford, surface condensing plant, £875; Messrs. Oliver & Co., Woolwich, 40 arc lamps, switches, and transformers, £588.

FORTHCOMING EVENTS.

Friday, May 17th.—Society of Arts. Howard lecture, by A. C. Eborall, "Polyphase Electric Working." Lecture IV.—The polyphase transmission line: overhead and underground work—The effects of capacity and inductance on the working of the system—The fundamental calculations of polyphase transmission systems and installations — The regulation of polyphase systems.

At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Closing business meeting, to be held in the Lecture Hall of the Literary and Philosophical Society, Westgate Road, Newcastle-upon-Tyne. The discussion on Mr. Edwin Griffith's paper on "Water-tube Boilers" will be resumed and closed. Mr. Edwin Griffith will reply.

Saturday, May 18th.—At 10 a.m. Institution of Electrical Engineers (Students' Section). Visit to the works of Messrs. Elliott Bros., Lewisham.

Monday, May 20th.—At 6 p.m. The Institution of Junior Engineers. Visit to the works of the Renewable Electric Lamp Company, Brunswick Place, City Road, N.

Wednesday, May 22nd.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham Section). The last meeting of the session will be held in the Physical Theatre, the University, Birmingham. Discussion on Mr. A. C. Eborall's paper, "Some Notes on Polyphase Sub-station Machinery."

Thursday, May 23rd.—At 3 p.m. Royal Institution. Prof. Dewar, F.R.S., will commence a series of three lectures on "The Chemistry of Carbon."

At 7.30 p.m. Institution of Electrical Engineers (Dublin Section). Annual general meeting, to be held at the Royal College of Science, Dublin. Paper by W. Tatlow, entitled "Note on the Arrangement of Accumulators in a Small Installation."

Friday, May 24th.—At 9 p.m. Royal Institution. Lecture on "The Aims of the National Physical Laboratory," by R. T. Glazebrook.

Thursday, May 30th.—The Electrical Standardising, Testing and Training Institution. Prof. C. A. Carus-Wilson M.I.E.E., will commence a series of lectures to the senior students of the above Institution upon "Dynamo and Motor Construction."

NOTES.

Held Over.—We have received just as we are going to press, and too late for insertion in this issue, a communication from Mr. Arthur Bergtheil on the "Electric Blowing at Lincoln Cathedral." The same remarks apply to one on "The British Press and British Industry," by Mr. T. W. Sheffield.

Newport Electric Tramways.—The battle of the sites over the new power station continues to cause a great amount of public interest. The committee recommend the erection of an entirely new station on a site in Corporation Road, purchased from Lord Tredegar. The opposition say that if this is done, everything in the old works will have to be scrapped, and they argue that there is room for the additional requirements on the present site. At the last meeting of the Council, the matter was referred back to the committee, but they refuse to budge from their position. At the Council meeting on Tuesday, Mr. H. F. Parshall presented a lengthy report, in the course of which he said :—

> In attempting to separate the traction installation they would be handicapping an enterprise, which will on the most conservative estimate bring in a net profit to the Corporation of from £15,000 to £17,500 per annum. This figure is a most conservative one, and assumes from 11d. to 1s. earnings per car mile, and from 5d. to 6d. working cost. Against the suitability of Friars Street site, Mr. Parshall instanced insufficient space; increased cost of foundations; increased cost of building, owing to the congested area; lack of facility for contractors and greater length of time to complete the building; increased vibration in the neighbourhood; and the impossibility of using cooling towers, since such an amount of moisture and condensed steam would be given out in the air that the Corporation would be immediately subject to litigation. Moreover, the present coal conveying plant could not be adapted to the larger installation and the coal conveying plant would have to be more elaborate and costly than that necessary for the Corporation Road site. The least net earnings to be expected from the tramways were from £15,000 to £17,500, and the least gross earnings £35,000. The net earnings from the power installation would be £2,780 on the basis of a load-factor of 24 hours a day, and an average price of 1½d. per unit..

The Committee having questioned Mr. Parshall, passed a resolution still recommending the Council to accept the tenders referred back at the last meeting. Mr. Copland stated that he had made an investigation into the capacity of the present station. He declared that they had room to generate another 1,800 KW. in the present building, and with extensions another 1,500, making a total of 3,300 KW. Their present output was only 600; another 350 would be required for cars. They could put down three more boilers, and also could extend the boiler house for seven additional boilers, which would give 6,000 H.P. Councillor Parry said the Corporation obtained powers for the expenditure of £130,000; they were now told the estimated cost was £200,000. After a discussion lasting several hours, it was decided to considerably modify the scheme. A station will be erected on the Corporation Road site for traction purposes only, and two 500-KW. sets will be ordered instead of three recommended by the Committee.

Manchester Electrical Tramways.—Trial trips have been made on the Cheetham Hill route into the city with the new electrical tramways, and are reported to have been thoroughly satisfactory. It is not probable, however, that the cars will be running in Whitsun week, although when the inspection is made by the Board of Trade everything will be found in readiness for the inauguration of the service. The next batch of lines to be dealt with will be in the South Manchester district, and not Stockport Road and Hyde Road, as stated.

Obituary.—In our last issue we briefly recorded the details of the failure of A. W. B. Pearson, whose public examination had been arranged for next month. The latter event will not now take place, for we regret to state that by his own hand he has removed himself far from that possibility, having shot himself at the Manchester Hotel, Aldersgate Street, E.C., on Tuesday, May 7th, just as he was about to be arrested in connection with a charge of forging and uttering a bill of exchange for £60. Evidence showed that deceased had, for some time past, carried a bottle of morphia in one pocket and a revolver in another; the jury, however, brought in a verdict of suicide during temporary insanity.

We regret to record the death of Mr. A. H. Roe, borough electrical engineer of Bury St. Edmunds, which occurred in London on Friday last after a few weeks' illness. In his time Mr. Roe had been a sea-going electrical engineer in the service of the P. & O. Steam Navigation Company. He had charge of the electrical equipment of the hospital ship *Coromandel* on the Ashanti expedition. Following this he spent three years in the electricity works at Bradford as assistant electrical engineer, and from thence went to Bury St. Edmunds.

Patent Laws.—In the House of Commons on Tuesday, Mr. Balfour was asked by Mr. H. Lewis whether the Government proposed to introduce legislation to carry out the recommendations of the committee appointed by the Board of Trade to inquire into the working of the Patents Acts on certain specified questions. Mr. Balfour replied that the report of the committee and the recommendations contained in it were of considerable importance, but had not yet been fully considered. There was no possibility of being able to give effect to them during the present session. It would be satisfactory, however, if time permitted, to deal with the point which formed the subject of international agreement, and also with the point relating to compulsory licenses, and with this object a Bill would be prepared.

Personal.—The second number of our contemporary *Traction and Transmission* is published. It is interesting to read in the *Street Railway Journal* that "although his name does not appear in the paper, we understand that Philip Dawson, of Robert W. Blackwell & Co., Limited, is the editor of the new paper. Mr. Dawson's high reputation as an engineer and writer will ensure the future success of this publication."

We are pleased to note that the King of Denmark has conferred on Mr. J. Denison Pender, managing director of the Eastern Telegraph Company, the decoration of the Danneborg, Mr. Denison Pender becoming a Knight Commander. Mr. Hibberdine, the accountant, and Mr. Hesse, the secretary, have also been honoured, receiving from his Majesty the Companionship of the same order.

Mr. E. W. Silcock, formerly with the Volt Electrical Company, Limited (Messrs. Edwards & Barnes) has severed his connection with that firm, and has joined the staff of Mr. Jas. Calmon, electrical accessories manufacturer and agent, Birmingham.

Glasgow Exhibition.—The record attendance of 117,000 obtained at the last show in 1888 was broken on Saturday, 11th inst., when 135,894 persons passed the turnstiles, making the attendance up to the 13th inst., from 2nd inst., a grand total of 751,420, compared with 344,420 for the same period in 1888. Everything points towards a very successful run. The generating plant, or, at least, a greater part, is now in full working order.

Paris Electric Cabs.—The electric cab service of Paris has proved a complete failure financially. The vehicles were taken off the streets about six months ago.

Royal Institution.—Last Friday evening Prof. J. Chunder Bose discoursed on "Response of Inorganic Matter to Mechanical and Electrical Stimulus."

Lectures.—A special course of four lectures on "Electrochemistry" is to be delivered at the East London Technical College, by Dr. R. A. Lehfeldt, on Thursday evenings in June.

Appointments Vacant.—An electrical engineer is wanted by the Walthamstow U.D.C. at £300 per annum. A lecturer in electro-technics is wanted for University College, Liverpool, at £200 per annum (and half of the fees). A railway telegraph inspector is required for the Federate Malay States Railways, on a three years' engagement at $150 per mensem. A resident electrical engineer at £250 per annum is wanted for Maidstone.

For Sale.—Messrs. Henry Steel & Son are to sell by auction certain electrical and other plant and machinery on the premises of the Phœnix Process Trust, Limited, of Milton, on June 18th. Messrs. Wheatley Kirk, Price & Co. are offering for sale several sets of electric lighting plant by different manufacturers. The same firm is open to sell a large quantity of machine tools now at the Victoria Foundry, Leeds. Details of these notices will be found among our advertisements to-day.

The B.A. Meeting.—The British Association meets at Glasgow, under the presidency of Prof. A. W. Rucker, from Wednesday, September 11th until 19th. It is interesting to remark that the Association met in Glasgow 25 years ago (1876) for the third time. It is anticipated that this will be one of the largest congresses the B.A. has ever held. The fact that Glasgow is just now "Exhibition City," and is to be the meeting place for nearly all engineering and scientific societies this year, leads the Association to this belief. The honorary secretaries are Sir J. D. Marwick, Mr. John Young, Prof. Magnus Maclean, and Mr. J. S. Samuel is the acting secretary. Section A will be under the care of Major P. A. MacMahon, F.R.S., and Section G (now styled "Engineering") will be presided over by Col. R. E. Crompton. Evening discourses will be delivered by Prof. Ramsay and Mr. F. Darwin. In spite of the number of other engineering congresses in which electrical engineers will be taking part this year, it is sincerely to be hoped that they will be prepared to do their best to ensure the success of Sections A and G from an electrical point of view. All communications respecting original papers should be addressed to the general secretaries at Burlington House, W.

Atkins and Applegarth v. Castner-Kellner.—Mr. Justice Buckley yesterday gave judgment in favour of plaintiffs and dismissed the action with costs.

The American I.E.E.—The summer meeting of the American Institute of Electrical Engineers is to be held at Buffalo, commencing on Wednesday, August 14th, and closing probably on 24th. We have received a copy of the preliminary programme. One feature of the meetings is the reception of European guests, to whom a hearty invitation was given at the Paris Electrical Congress of last year.

CITY NOTES.

Kidderminster and District Electric Lighting and Traction Company.

THE directors' report, to be presented at the meeting to be held at Donington House, W.C., at 2.30 o'clock p.m. to-day, reads as follows:—

The directors beg to submit their report and statement of accounts for the year 1900. The total capital expenditure to December 31st, 1900, on account of buildings and plant for electric lighting amounted to £14,2-7 3s. The gross receipts, including the amount receivable from the Kidderminster and Stourport Electric Tramway Company for dividend on the shares held by this company, amount to £1,778 10s. 3d., which, added to £1,145 19s. 4d. brought forward from last account, makes £2,924 9s. 7d. After deducting the expenses (including interest on loans), amounting to £767 4s. 2d., there remains a net profit of £2,157 5s. 5d. The directors propose that this amount should be applied as follows, viz.:—

To dividend on cumulative preference shares for the year 1900	£1,449	2	2
To be carried forward to next account	708	3	3
	£2,157	5	5

The directors attach to this report a copy of the balance sheet and profit and loss account of the Kidderminster and Stourport Electric Tramway Company. The net profits for the year in respect of the tramways amounted to £2,103 14s. 10d., which, added to £92 14s. 11d. brought forward from last account, make a total sum available of £2,201 9s. 9d. This amount has been applied as follows, viz.:—

To dividend of 5s. 6d. per share on 5,720 shares	£1,573	0	0
To depreciation fund	500	0	0
To be carried forward to next account	128	9	9
	£2,201	9	9

The public supply of electric energy for lighting and power was begun on August 22nd, 1900. From the commencement there has been an active demand for light, the actual number of lamps connected to the mains being now equivalent to 5,760 of 8-C.P., and applications have been received for a further 162 8-C.P. lamps. Some of the manufacturers have been induced to try electric motors for driving their machinery, and the installations already made have been attended with most satisfactory results; so much so, that the company has now more applications for power than the present plant can supply. New generating machinery is on order and nearly ready for delivery, which will increase the available power by 600 KW., equal to 800 H.P. Mr. Emile Garcke and Mr. C. Shirreff Hilton have resigned their seats on the board, and the vacancies thereby created have been filled by the appointment of Mr. R. P. Sellon and Mr. Geo. Stevens. Mr. D. F. Sugrue has been appointed a director of the company. Messrs. J. S. Raworth and J. A. Lycett are the directors who retire by rotation, and they are eligible for re-election. Messrs. Walter J. Kershaw & Co., the auditors, retire, and they offer themselves for re-election.

TRAMWAYS.

	M.	F.	Ch.
Miles open—			
Route miles ...	4	4	7
Single line ...	4	2	4
Double line ...	0	2	3
Number of passengers carried	752,157		
Average receipts per passenger	1·78		
Average expenditure per passenger	1·18		
Proportion of expenses to receipts	65 p.c.		
Number of cars in stock	13		

An extraordinary general meeting follows the ordinary meeting, to pass resolutions altering the articles.

Bastian Meter Company.

THE directors' report for the 12 months ending February 28th, 1901, to be presented at the meeting to be held at Bartholomew Works, Kentish Town, N.W., on Thursday, May 23rd, reads as follows:—

Your directors have the pleasure to submit to you the third annual statement of accounts for the 12 months ending February 28th, 1901. The small profit earned could have been considerably increased, but for the fact that it was considered advisable to replace, free of cost, certain defective meters sold by the company in previous years. In this way your customers have been retained, and the value of the goodwill of the company has been preserved. The principle and construction of the Bastian meter received the official approval of the Board of Trade on July 27th, 1900, and the constant substantial repeat orders received show that the instruments are considered by engineers to be serviceable and efficient. Mention may be made of one important municipality that has over 500 Bastian meters in use, with most satisfactory results, and many other similar instances could be cited by way of proof that it is now a readily saleable and commercial article. With the experience of the past three years before them, your directors now feel complete confidence that the present construction of the meter is good, mechanically and electrically, while the design admits of economical and methodical manufacture. The present arrangement with the British Electric Meter Company, Limited, for the sale and distribution of the meters, is not so satisfactory as was anticipated when the agreement was made with them in January, 1898. Under that agreement the British Electric Meter Company, Limited, paid this company the sum of £2,500 and acquired the sole selling rights in the United Kingdom. As a result of difficult negotiations we have now succeeded in obtaining the option to cancel this agreement by the repayment of the sum of £3,500 plus £500, which may be regarded as interest for the period of over three years. A meeting was recently convened between the directors and several of the largest shareholders, when it was decided to recommend that this option be exercised, as it was the unanimous opinion that the present arrangement is not economical, and that a much larger sale could be obtained with undivided control over the manufacturing and selling department. Subject to the approval of the preference shareholders, it is proposed to create first mortgage debentures bearing interest at the rate of 6 per cent. per annum, to the value of £6,000. Of this sum, £5,000 will be immediately offered for subscription amongst the shareholders, for the purpose of providing funds for the above option, and further working capital. With regard to the item standing to the debit of profit and loss account in the balance-sheet, it has been suggested by certain holders of vendor shares, that all the vendors should be asked to surrender a proportion of the shares they hold in the company, sufficient to expunge this item from the accounts. The directors have again relinquished their fees for the period under notice. Mr. Ciantar retires from the board in rotation, but being eligible, offers himself for re-election. The auditors, Messrs. Percy Mason & Co., also offer themselves for re-election.

New General Traction Company.

THE report of the directors for the year ended March 23rd last, to be presented at the meeting to be held on 21st inst., states that the gross profits were £41,087 after deducting £10,740, the amount of general expenses, salaries, directors' fees, interest on loans and £1,389 expended on new business not proceeded with, with £37,031 brought forward, making a total of £78,118. After allowing for preference interest the directors proposed to transfer £7,000 to reserve against goodwill; £182 to meet a difference in the value of Consols held, and £10,000 to the general reserve account. The amount of the general reserve will then stand at £30,000, and the reserve against goodwill at £20,000, leaving a balance of £45,936, out of which the directors propose a distribution of 4 per cent. for the year on the ordinary shares, leaving £41,136 to be carried

forward. The system at Philadelphia has nine miles now working, and it is expected the entire system of 20 miles will be finished and in operation by next July, but little further capital expenditure being required to complete the system. To meet this and cover the amount of the outstanding loans the directors have created and propose to issue £200,000 of 5 per cent. redeemable debentures, and these will at once be offered for subscription.

Announcements re Companies.

The following companies are to be struck off the register within three months unless cause is shown to the contrary:—

Brothers Smokeless Furnace Company, Limited.
Davy Improved Arc Lamp Syndicate, Limited.
District Electric Supply Company, Limited.
Electrical Industries, Limited.
Electric Light Railways, Limited.
Electro-Metallurgical Company, Limited.
Folkestone District Electric Railways Company, Limited.
Great Yarmouth and District Tramways Company, Limited.
Hamilton, Motherwell and Wishaw Light Railways Company, Limited.
Rochester, Chatham, Gillingham and District Electric Railways Company, Limited.

Stock Exchange Notices.—The Committee has been asked to allow the following to be quoted in the Official List:—Central London Railway—£2,062,970 ordinary stock, £393,515 4 per cent. preferred stock and £393,515 deferred stock, in lieu of the shares now quoted. The Committee has also ordered the undermentioned securities to be quoted in the Official List:—Notting Hill Electric Lighting Company, Limited—Further issue of 2,?00 ordinary shares of £10 each, fully paid, Nos. 10,001 to 12,200.

West India and Panama Telegraph Company.—The report for the last half of 1900 shows a balance of £3,337, and after adding interest on investments and an amount brought forward, the sum was insufficient to pay the cumulative dividends on first and second preference shares. The board thinks it prudent not to pay dividends from the reserve this year, but to carry £6,670 forward.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending May 10th were £530; corresponding week last year, £446; increase, £84. Total to date, £8,312; corresponding period last year, £7,451; increase, £861. Miles of track open, 8½.

Blackpool and Fleetwood Tramways.—The receipts for the week ending May 11th were £335; corresponding week last year, £332; increase, £3. Total to date, £4,285; corresponding period last year, £4,584; decrease, £299.

Bristol Tramways and Carriage Company.—The receipts for the week ending May 10th were £4,806; corresponding period last year, £2,850; increase, £1,456.

Central London Railway.—The receipts for the week ending May 11th, were £6,514; previous week, £6,428; increase, £86. Total receipts to date (19 weeks), £117,537. Miles open, 6.

City and South London Railway.—The receipts for the week ending May 12th were £2,015; corresponding week last year, £1,380; increase (Moorgate extension open) £635. Total to date, £37,731; corresponding period last year, £23,626; increase, £14,105. Miles open, 1901, 4½; 1900, 3½.

Dover Corporation Tramways.—The receipts for the week ending May 11th were £197 6s. 8½d.; corresponding week last year, £177 19s. 6d.; increase, £19 7s. 2½d. Total to date, £3,268 0s. 0d.; corresponding period last year, £3,020 18s. 9½d.; increase, £247 1s. 2½d. Miles of track open, 3; Car miles run, 1901, 5,061; 1900, 4,934. Number of cars, 1901, 11; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending May 10th were as follows:—D. U. T. Co., electric cars, £3,521 1s. 11d.; D. S. D. Co., electric cars, £779 9s. 2d.; total £4,302 11s. 1d.; corresponding week last year—D. U. T. Co., electric cars, £3,452 9s. 9d.; ditto, horse cars, £55 3s. 5d.; D. S. D. Co., electric cars, £822 11s. 5d.; total, £4,330 4s. 7d.; decrease, £27 13s. 6d.; aggregate to date, £73,849 7s. 8d.; aggregate to date last year, £75,656 11s. 11d.; decrease, £1,807 4s. 3d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and 2 miles by horses, for the corresponding period last year.

Glasgow Corporation Tramways.—Receipts for week ending May 4th, 1901, £11,756 11s. 1d., as compared with £9,194 1s. 1d. for same period last year. Week ending May 11th, 1901, £10,691 3s. 9d., as compared with £9,183 0s. 9d. for same period last year.

Liverpool Overhead Railway.—The receipts for the week ending May 12th were £1,616; corresponding week last year, £1,416; increase, £200. Total to date, £29,167; corresponding period last year, £26,752; increase, £2,415. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The pricking of the tremendous bubble of speculation blown in the American Railroad market has left the Stock Exchange exhausted and anxious. While everybody knew that an end must come, there were few who foresaw the psychological moment for the explosion of the mighty boom. And so there has been trouble in the markets. Sales of investments have had to be made in order to pay losses incurred elsewhere. Led by Consols, the gilt-edged departments dipped deeply, but are now recovering a trifle. All things considered, the electrical markets have suffered but little; more, perhaps, from want of business than from anything else. The Stock Exchange has received a severe shaking, and it will probably be some weeks before it throws off the maleficent influence of the Yankee Railroad panic.

Important changes, however, there are few. In Supply section a rise of 10s. in Metropolitans is counterbalanced by an equal fall in Westminsters. Buyers are coming forward for Metropolitans upon the taking-over of part of the company's undertaking by the Marylebone Council, of which we gave particulars last week. Some curiosity is being expressed as to the way in which the Metropolitan Company will deal with the money received from this sale. Our own opinion is that the directors will apply at least a part of it towards reducing the Debenture issue of the undertaking. Including the last emission there is £470,000 Debenture stock in the hands of the public, and an excellent opportunity now presents itself for reducing this indebtedness. To account for the drop in Westminsters, it is stated that holders are selling these and buying Metropolitans. The new Ordinary shares of the latter stand at 12½, or 10s. below those of the senior issue. County Debenture is a point down, but the rest of the gilt-edged stocks show no variation on the week.

City and South London stock, in the Railway Market, is up again to the tune of 1 per cent., and the cause of the movement is still enshrined in mystery. Waterloo and City remains at 95½. Central Londons declined a fraction upon the finding of the Vibration Committee, but easily recovered. The dealers in the market declare that the Committee's suggestions have not influenced business either way. Asked whether he considered that the proposals would involve a heavy capital expenditure, a well-known jobber in Central London shares replied that he should say not, and this is the general view taken in the Stock Exchange. The board are now considering various improvements, which have for their object the acceleration of the service, but as certain Parliamentary powers must be obtained, the matter will probably have to wait for some time. The Preferred halves are down on the week. District stock at 30¼ and Metropolitans at 80 show fractional gains.

The Telegraph Market is irregular. Rises of 3 per cent. and 2 per cent. have taken place in Submarine Cable Trust and Eastern Ordinary respectively, but the Anglo-American group is weak. The Deferred stock of the Anglo Company relapsed to 10¾ upon the appearance of an exceedingly heavy rate charged for carrying-over, and the Ordinary stock drooped in sympathy. Directs, notwithstanding the Yankee slump, retain their last week's rise. Eastern Ordinary has scored again, and is justifying the remarks anent its cheapness which we made a fortnight ago, when the price was 4 points lower. West African Telegraph Debentures have found supporters; the bonds seem cheap enough as a second grade investment at par, their present value. Amazon Debentures are also to the fore, and after being almost dead for months past have recovered part of the nominal loss which they suffered upon the appearance of the last report. Globe Telegraph Ordinary are lower at a shade below 10, having been sold by some holders who wanted the money to pay losses in Yankee Rails.

National Telephones gamely resist the general air of depression pervading the Stock Exchange, and again record an advance. Not only the Ordinary, but the much-abused Third Preferences, are being bought, and the latter look a likely gamble for the rise. Other telephone descriptions are quiet, Orientals being quoted at a trifle lower, *ex* dividend.

Industrial shares incline to weakness, but India-rubbers are better, showing a rise of 10s. Telegraph Constructions have shed £1, although this is offset by a rise of the same amount in the Debenture bonds. Henley's and Callender's do not move. In the traction market, British Electrics are a shade lower; the voice of the American is heard elsewhere; Calcutta trams at 7¼ are minus the dividend.

As Saturday, May 18th, is the centenary of the Stock Exchange it is interesting to glance for a moment at the part played by electricity in the world's greatest market. The House is lighted entirely by electricity, supplied from the installation in its vaults. The installation consists of two large Lancashire boilers, two Robey engines driving three Wolverhampton dynamos, and a Parsons steam turbine, with dynamos attached. The current generated is stored in accumulators placed in the roof of the Stock Exchange. As regards telegraphy, it is nothing unusual for 20,000 wires to be sent on a single day: the record number of messages is 28,142, to be exact. The Stock Exchange owns 60 private lines to the various provincial exchanges, to say nothing of an elaborate telephonic service supplied partly by the National Telephone Company and partly by the Exchange Telegraph Company. With the feeling of astonishment that is produced by the contemplation of the strides made during its lifetime comes another of wonder as to what will happen in the Stock Exchange if it survives for another hundred years.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations May 8th.	Closing Quotation May 15th.	Business done during week ended May 15th, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs	100	...	...	...	99 —102	99 —102	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	55 — 65	66 — 71	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	55 — 58	53 — 56	54	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	98 —100	97 — 99	99¾	97½
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	11 — 11½	10 — 10½	11	10 7/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3½— 4	3¼— 3⅜	3⅜	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	101½	100¼
16,000	Cuba Telegraph	10	8 %	7 %	...	7½— 8½	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	16 — 17	15 — 16	15½	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 — 104%	100 —104%	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	10 — 10½	10 — 10½	10⅜	10 5/16
108,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	137 —142	139 —144	142	139
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	91 — 94	91 — 94	94	91½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	110 —114	110 —114	111½	111
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13½— 14	13½— 14	14	13⅜
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) ...	10	...	...	...	13½— 14	13½— 14xd	13 9/16	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	111½	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99 —102 xd	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	...	9⅜— 10¼xd	9½— 10	9 1/16	9⅜
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜— 15½xd	14⅜— 15½	15⅛	14⅜
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	34 — 35	33 — 35	...	...
82,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	45 — 49	43 — 47	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅜— 1	⅜— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3¼— 3½	3⅜— 3⅝	3 9/16	3⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4 — 4¼	4⅛— 4⅜	4¼	4 1/16
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	87 — 90	87 — 90	89	87¼
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98	95 — 98	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	15/16— 1 1/16	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	...	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	121 —126	124 —129	124	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4½— 5	4½— 5	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅝— 5¼	4⅝— 5¼	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	97 —100	98 —101	99½	98½
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜— 14¼	13⅜—14¼	13⅞	13 13/16
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104	101 —104	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	6 — 7	6 — 7	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½— 9	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5 7/16	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅜— 6¼	5⅜— 6¼	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8½— 9½	8½— 9½	8¾	8 1/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8 — 9	8 — 9 xd	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	11 — 12	11 — 12 xd	11⅞	11½
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	106 —109	105 —108	...	...
35,500	*Edmundson's Elec. Corp., Ord. Shares	5	7 %	...	...	5 — 5½	5 — 5½	5⅝	5⅝
13,363	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6	5 1/16	...
75,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	103 —106	103 —106	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	102 — 105	102 —105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1¼— 1¾	1¼— 1¾	1⅝	1½
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	98 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	12 — 13	12¼— 13½	13⅜	12⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	98	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	12½— 13½	12 — 13	12⅝	12¼

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation May 8th.	Closing Quotation May 15th.	Business done week ended May 15th, 1901. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7⅞ — 8⅛	7⅞ — 8⅛	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	85 — 93	87 — 93	...	...
45,000	British Electric Traction	10	6 %	...	...	15 — 16	14½— 15½	15	...
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅜	...
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	119 —122	119 —122	121½	120½
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	... ...	... ...	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	... ...	... ...	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	... ...	... ...	...	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11	10 — 11	10⅛	10⅜
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅜— 6½	5⅜— 6½	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝— 1⅞	1⅝— 1⅞xd	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼xd	2 3/16	2⅛
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —103	101 —103	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14½— 15½	14½— 15½	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅝	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9¼— 9⅝	9½— 10	9⅝	9⅜
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4½— 5	...	...
78,703	Do. do. Def. do.	5	...	...	...	4½— 5	4½— 5	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1½%	51 — 53	52 — 54	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 5½	5 — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½— 4	3½— 4	3⅝	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —104	101 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1½— 1⅝	1 — 1½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	3 — 4	2½— 3½	3⅜	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	87 — 89	87 — 89	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅜— 2¼	1⅜— 2¼	1⅜	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2⅜— 3¼	2½— 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½— 16½	15½ — 16½	16¼	15½
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½— 6	5½— 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½— 21½	21 — 22	21¼	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅝%	3¼%	7 1/16— 8 1/16	7 1/16— 8 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13¼	13 — 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	36 — 40	36 — 39	37½	37
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 —104	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	...	10½— 11½	10½— 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 6	5½— 6	5⅝	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	94 — 97	94 — 97	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 3/—4/-
National Electric Free Wiring, 12/6 paid, 3/16—11/8.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (February 21st, 1901).

MARKET QUOTATIONS, Wednesday, May 15th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	83/-	83/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£90	£90	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160°C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8½d.	8½d.	..
a ,, Caustic (76/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	61/-	61/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6 5s.	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £130	£75 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	7½d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8½d.	8½d.	..
c ,, Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10½d.	10½d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£85	£85	..
c ,, (Electrolytic) Bars ..	per ton	£82	£82	..
,, ,, Sheets ..	per ton	£90	£90	..
c ,, ,, Rod ..	per ton	£84	£84	..
c ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	3/9 to 3/9½	3/8 to 3/8½	1d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	46/3	46/3	..
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10 5	£10 5	..
g Lead, English Ingot	per ton	£12 10 to £12 15	£12 10 to £12 12 6	inc.
g ,, ,, Sheet	per ton	£15	£15	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/8	3/3 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4	1s. inc.
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40		..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£124 10 to £125 10	£122 to £123	£2 10 inc.
g ,, foil	per lb.	1/9	1/9	..
n ,, wire, Nos. 1 to 16	per lb.	1/8	1/8	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4¾d.	4¾d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 5	£14 5	..
k Zinc, Sh't. (Vielle Montagne pnd.)	per ton	£21 10	£21 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yeo & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON TEST-ROOM METHODS OF ALTERNATE CURRENT MEASUREMENT.

By Albert Campbell, B.A.

(*Paper read April 18th*, 1901.)

(*Concluded from page* 820.)

II.—*Inductive Loads.*—As several types of energy-meter suitable for measuring inductive loads are now in common use, it is often necessary to test with inductive loads going down to power factors of 0·6 to 0·7. To use an ordinary wattmeter as standard is objectionable, as its errors may be as large as those of the watt-hour

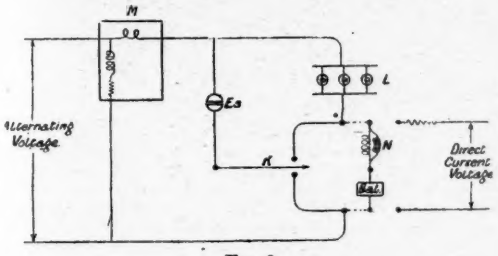


Fig. 8.

meter under test. I have used the following method (7) for some years past and have found it convenient and accurate.

Method 7.—This is shown in fig. 8, in which M is the watt-hour meter under test. The load consists of a non-inductive resistance L in series (through mercury pools) with an inductive part consisting of a Kelvin balance and a set of copper coils (N) wound inductively. In order to be able to make sudden measurements of the resistance of this inductive portion, mercury cups are so arranged that it can be quickly switched over into connection with a direct-current circuit and the resistance measured by reading current and P.D. on a Weston instrument. While the meter is running, the current C is read on the balance, and by the help of the switch K the voltage V on L and the total voltage U are read on the electrostatic voltmeter E *s*.

If r = mean resistance of the inductive part, then—

$$\text{Power} = C\,V + C^2 r,$$

and

$$\text{Power factor} = \frac{W}{C\,U}$$

In practice r is made as small as possible, so that a small error in $C^2 r$ has a very small effect upon the value of W, while the C V part can be measured with extreme accuracy. The coils which make up N must have no iron near them, eddy currents must be avoided, and mutual induction must be guarded against except where two of the coils are identical in winding, in which case their impedance in parallel can be conveniently varied by varying their relative positions. The method is also suitable for testing wattmeters.

Method 8.—I have sometimes found it convenient to use a some-

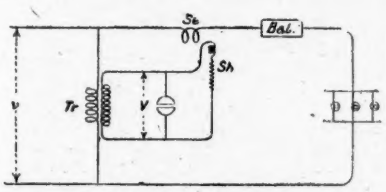


Fig. 9.

what different method by which the measurement of resistance is rendered unnecessary. This consists simply in measuring w, the power in the highly inductive part, by the 3-voltmeter method (or by an ordinary wattmeter), the total power being C V + w. Since w can be made to be only a small part of the whole power, this is accurate enough, and the coils N may here have iron cores.

III.—*Fictitious Loads.*—Unfortunately it very often happens that sufficient power (at the proper frequency) is not available to allow the meter to be tested with the actual loads at which it is to be used. It thus becomes necessary to arrange fictitious loads whose action on the watt-hour meter shall be practically identical with that of the corresponding real loads.

Method 9.—When the source of supply can furnish the current, but not at a voltage quite high enough for the load required, the well-known arrangement shown in fig. 9 may be used. The shunt coil *Sh* is disconnected from the series coil *Se*, and is connected with a transformer *Tr* which raises the supply voltage v to a suitable value V. The voltage v must be high enough to allow the series circuit (series coil, balance, and lamps) to be practically non-inductive.

Method 10.—When a large current is required, a method which I have published recently will be found useful. In it the large current obtained at a low voltage passes through the Kelvin balance, the series coil of the meter, and a low non-inductive resistance; a transformer of high ratio, with its primary across this low resistance, furnishes from its secondary the volts for the shunt circuit.

Section C.—*Thermopile Methods.*—A well-known, but little-used, way of measuring a current consists in passing the current through a conductor near which are one set of junctions of a thermopile. With rightly chosen conditions, the deflections of the galvanometer connected with the pile are practically proportional to the square of

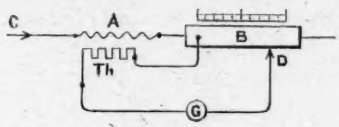


Fig. 10.

the effective value of the current. In common with many other thermal methods, the action is dead-beat, but there is usually the accompanying disadvantage of sluggishness, the zero point not being regained instantly on switching off the current. By making the hot wire and the junctions extremely small, this sluggishness can be much reduced. I have tried a thermopile of iron and nickel wires of 0·15 mm. (6 mils) diameter; from a deflection of 100 divisions (400 mm.) the light spot, after the switching off of the current, returned to within 1·5 divisions above zero in 30 seconds, and was still 0·5 division from zero after 75 seconds. This is prompt enough for many purposes, and it is no difficult matter to braze the junctions of such a thermopile. I have succeeded in brazing junctions of much thinner wire and gained considerably in promptness of working, but this gain scarcely repaid the extreme difficulty of construction.

Method 10.—I may mention here a somewhat interesting null method of measuring continuous current which I have tried; it is shown in fig. 10. The current passes (wholly or in part) through the thin wire A and also through B, a strip or rod of very low resistance. The heating of A by the current causes the pile *Th* to give an E.M.F. e, which is balanced against a part of the voltage-drop along B by moving the slider D until the deflection of the detector galvanometer G is brought to zero. Here $e = k\,C^2$ and $v = r\,C$, r being the resistance of the fraction of B for which $e = v$.

Then $r = k\,C$, and hence the graduations of the scale of the slider are directly proportional to the current measured.

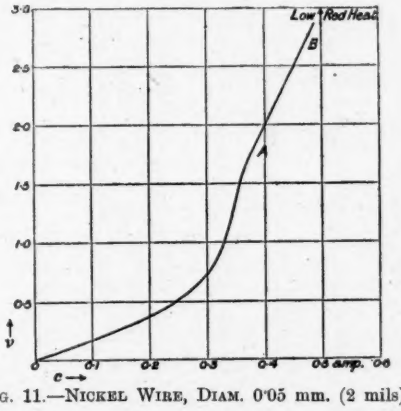


Fig. 11.—Nickel Wire, Diam. 0·05 mm. (2 mils).

Section D.—*On obtaining Steady Currents.*—In accurate testing work it is of great advantage to be able to obtain very steady currents and voltages. By the help of an automatic thermal arrangement I have succeeded in obtaining very exact regulation, even when the supply voltage is varied by 10 or 12 per cent. The method depends upon the alteration of resistance due to rise of temperature. In the following description I shall take a concrete instance with wires of nickel and manganin as typical of conductors of large and small temperature coefficients respectively.

If a curve be drawn for any conductor showing the connection between c, the current through the conductor, and v, the voltage applied to its ends, the form of the curve will depend on the material of the conductor and on the temperatures to which it is raised by the current. It is convenient to call this curve the *Characteristic* (*Curve*) of the conductor. I assume that, in drawing the characteristic curve, steady conditions of temperature are reached at all points. For manganin, not overheated, the characteristic is practically a straight line whose steepness measures the resistance of the conductor, but for a thin wire of nickel the characteristic curve is of the form shown in fig. 11, which is drawn from an actual experiment with wire of 0·05 mm. (2 mils) diameter. It will be noticed that *the higher part of the curve* (*from* A *to* B) *is very nearly a straight line.*

Method 11.—Now let a Wheatstone's bridge be arranged, as in fig. 12, in which the arms D F and G H are equal resistances of nickel, while D H and F G (also equal to one another) are of

manganin. In fig. 13 let O, A, B, and O, K, be the characteristic curve of D, F and F, G. Then it is easy to show that as long as the branch from F to H is kept on open circuit the potential difference from F to H for any particular value of the current, *c*, will be proportional to the vertical distance between the two characteristic curves. It is easy to choose the relative values of the nickel and manganin resistances, so that O, K shall be parallel to the straight

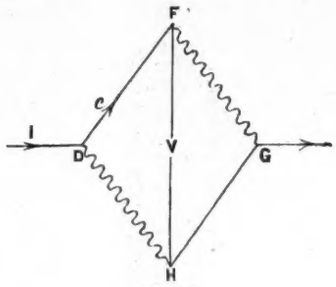


FIG. 12.

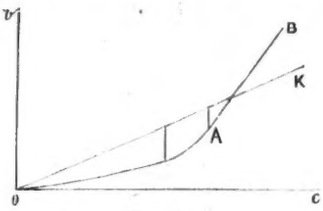


FIG. 13.

portion, A, B, as in fig. 14, and when this is the case *n*, *m* will be constant from A to B, and thus V *will be practically constant for all values of the current c corresponding to the part* A, B.

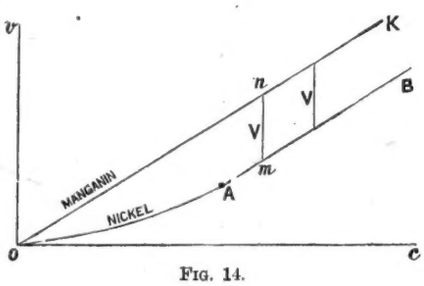


FIG. 14.

As I show in Appendix 2, this regulation also holds even when current is taken across F, H, the constant value of V, however, depending on the current taken. The construction for this case is shown in fig. 15 O, L is taken equal to C, the current through F, H

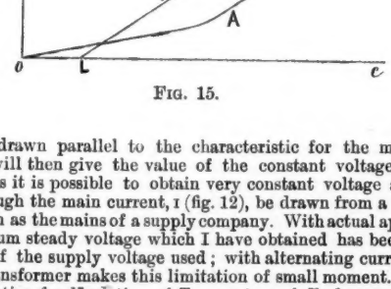


FIG. 15.

and L K is drawn parallel to the characteristic for the manganin wires; v^1 will then give the value of the constant voltage from F to H. Thus it is possible to obtain very constant voltage and current, although the main current, I (fig. 12), be drawn from a variable source, such as the mains of a supply company. With actual apparatus the maximum steady voltage which I have obtained has been about one-third of the supply voltage used; with alternating currents the use of a transformer makes this limitation of small moment.

Compensation for Variation of Temperature of Enclosure.—Unless the temperature of the enclosure containing the nickel wires can be kept constant it is necessary to introduce compensation for temperature. This can be done by replacing part of each manganin resistance arm by copper (in the same enclosure as the hot arms), sufficient cooling surface being allowed so as to prevent undue heating by the current. The curves in fig. 16 show the results of experiments at enclosure temperatures of 24° and 37° C., with a regulator compensated in this way. The arms of the regulator (in cyclic order) consisted of a 2-mil. nickel wire of 3·5 ohms; 20 ohms

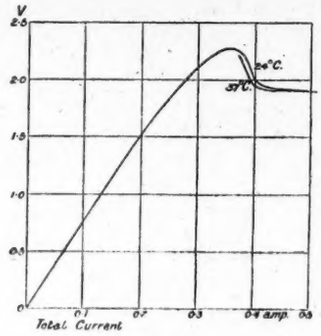


FIG. 16.

of manganin in series with 3·4 ohms of copper, and two equal manganin resistances of 125 ohms each. It will be noticed that near 0·45 ampere both the regulation and the temperature compensation are satisfactory. The level part of the curve (fig. 16) corresponds to temperatures of the nickel wire between about 400° and 600° C.

It would, I believe, be possible to obtain more extensive and better regulation by using platinum or other material instead of nickel, since the nickel has an abrupt bend in its temperature-resistance curve. Also, by replacing parts of the manganin arms by heated nickel, say, of larger diameter than that used in the other arms, it would be possible to make the upper characteristic bend up slightly, as in fig. 17, and so to attain more exact parallelism of the

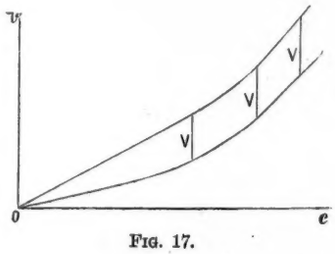


FIG. 17.

two curves, and hence better regulation. Again, by applying a once-regulated voltage to a second regulator, a much greater steadiness would be obtained.

Method 12.—It will be noticed that, in the above regulator, the function of the Wheatstone's bridge is merely to obtain the difference between the voltages on the nickel and the manganin resistances. With alternating currents the same may also be done by means of a transformer, as shown in fig. 18, where the transformer *Tr* is connected so as to give a regulated voltage at v.

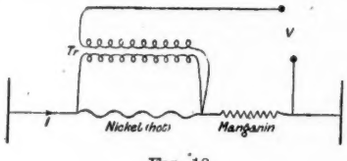


FIG. 18.

Uses of Regulated Voltages.—It is not difficult to find instances where regulated voltages would be of use in testing work; standard glow lamps may thus be run at constant brightness, shunts of watt-hour meters may be kept on constant voltage during test; with constant voltage the mere measurement of the current taken by an inductive coil usually gives an approximate indication of the frequency; a constant current from a supply circuit may be used to get direct readings in a simple electric resistance thermometer.

SECTION E.—*Null Methods of Measuring Current.*—If in the Wheatstone's bridge arrangement the resistances are so chosen that the characteristics intersect, as in fig. 13, then we may obtain, for I and V, a curve such as that in fig. 19, which is drawn from actual experiment (with direct current). With proper temperature compensation V vanishes for a perfectly definite value of the total current I, and if a sensitive detector be added the arrangement becomes *a thermal standard of current.* I have found a telephone with an intermittent contact in its circuit a convenient means of detecting the vanishing of V, the intermittent contact being of advantage even with alternating currents. The accuracy of such a standard is considerable.

Method 13.—If such a combination be put in series with a resist-

ance having a part adjustable by a sliding contact, as in fig. 20, it furnishes a simple null method of measuring a voltage (*e.g.*, of a supply company) which varies between small limits; the slider is adjusted to give silence in the telephone, and the corresponding value of the voltage is shown by the position of the slider. With alternating current the transformer method (12) is also applicable

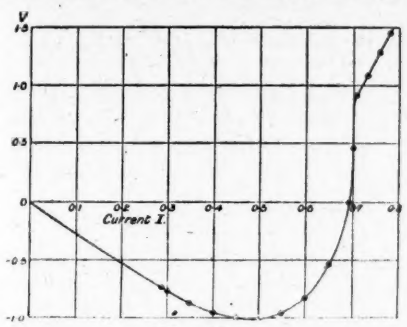


Fig. 19.

here, but a detector other than a telephone is necessary, for since the transformer alters the wave-form slightly, it is found impossible to get any position of complete silence with the telephone.

Method 14.—In conclusion, I may point out that if a voltmeter be put across v (fig. 12), it will be seen from the curve in fig. 19 that a

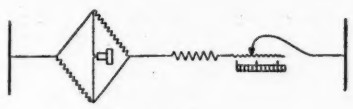


Fig. 20.

very open scale can be obtained, corresponding either to the total current I, or the outside voltage; this furnishes a thermally "set-up" instrument. I have found platinum better than nickel for this. Compensation for temperature can be applied as in the other methods.

[The paper was accompanied by two mathematical appendices.]

THE GERMAN PATTERN OF THE NERNST LAMP.

We have received from the Allgemeine Elektricitäts-Gesellschaft, Berlin, the following description of the lamp which, after long experimenting, they have evolved from the invention of Prof. Nernst. This company owns the patents for this country as well as for other north European countries, and their model is probably that which will be supplied to consumers here. The model differs considerably from that worked out by the English company owning the Indian and colonial patents, as may be seen by comparing it with the descriptions already published in the Electrical Review. The German model seems to be simpler than the English, but the description is not sufficiently detailed to enable us to judge with certainty on that point.

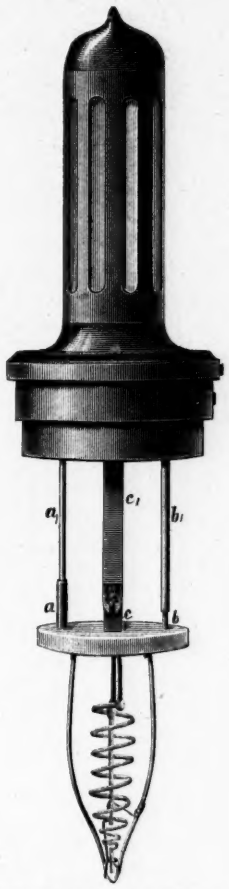
The advantages claimed for the Nernst lamp are the possibility of employing high E.M.Fs. at its terminals, and the small consumption of electric energy.

The efforts of the German company have been principally directed to the production of lamps consuming 40 and 80 watts, but they are also now prepared to supply lamps (Model A) taking 100 and 200 watts (*i.e.*, about 65 and 135 c.p.). Lamps of 40 and 80 watts (*i.e.*, about 25 and 50 candles, Model B) are for the present only let out on hire in Berlin. They hope, however, as their facilities for manufacturing increase, to have the latter model at an early date on the market.

The lamp, Model A, fills what has hitherto been a hiatus in electric lighting, by supplying us with a lamp of medium intensity, which is especially suitable, for example, for replacing groups of glow lamps. It consists essentially of the burner with its support (the lamp proper), and the suspender with the globe and series resistance, the latter having a very long life and being easily replaced. The only part consumed is the burner, which has an average life of somewhat more than 300 hours. No special skill is required to change the burner, since it is exclusively handled by means of the porcelain disc *p* to which it is fastened. On slackening the screw *s* the disc together with the burner can be withdrawn from its support. Interchange of the conductors when inserting a new burner is prevented by the arrangement and shape of the terminals; *a* and *b'* are tubes into which the rods *a'* and *b* pass when the disc is pushed up, and obviously this cannot be done if by mistake the terminals have been exchanged. When the burner has been inserted the screw *s* is tightened up, thereby connecting together the rods *c* and *c'* so as to form a continuous conductor, and preventing the burner falling out of the lamp.

The following figures are given to show the superior economy of the Nernst lamp when compared with the ordinary glow lamp.

Model A, 100 watts (about 65 candles) replaces four glow lamps of 16 c.p. each.



A.E.G. Nernst Lamp, Model A.

With current at 6½d. (55 pf.) per unit, and 600 hours' consumption per annum, the cost of supplying four carbon glow lamps is:—

$\frac{200 \times 600 \times 55}{1{,}000}$ =	M. 66	
Replacing four lamps at 55 pf.	2·20	
		M. 68·20
Nernst lamp $\frac{100 \times 600 \times 55}{1{,}000}$	33	
Replacing two burners at M. 2	4	
		M. 37·00
Saving per annum		M. 31·20

Percentage saving 45·75.

Model A, 200 watts (about 135 candles), replaces 8·5 glow lamps of 16 c.p.

With current at 6½d. (55 pf.) per unit and 600 hours' consumption per annum, the cost of supplying 8·5 carbon glow lamps is:—

$\frac{425 \times 600 \times 55}{1{,}000}$ =	M. 140·25	
Replacing 8·5 lamps at 55 pf.	4·68	
		144·93
Nernst lamp $\frac{200 \times 600 \times 55}{100}$ =	M. 66	
Replacing 2 burners at M 2	4	
		70·00
Saving per annum		74·93
Percentage saving	51·7	

The prices of the Nernst lamps are given as follows:

Model A.

100-watt (about 65-candle) lamp for				110-volt,	12s. 6d
100	"	"	"	220 "	12s. 6d.
200 "	135	"	"	220 "	14s. 6d.

Spare burners for the above three types 2s. each.

No account is taken of the greater first cost of the Nernst lamp in the above calculation of the saving as compared with the carbon lamp. This, however, would only reduce the saving by a small percentage.

THE GLASGOW EXHIBITION.

The Engineering Exhibits.

Electrical engineers who may be unacquainted with the neighbourhood of Glasgow should, before going to visit the Exhibition, arm themselves with one of the excellent maps which have been recently brought out for their express benefit. They can choose either that which has been enterprisingly prepared by Messrs. Alley & MacLellan or that of the Westinghouse Company. The former shows Glasgow and district, pointing the position of the "Sentinel Works," where the Alley & MacLellan engines are manufactured, and including the principal places of interest, among them hospitals, infirmaries, and the necropolis. The latter gives a map of the city, indicating that "everything in red is Westinghouse." It shows the streets through which the new trolley lines run, in connection with which the publishers have supplied a good deal of material of one kind and another, and the Westinghouse machinery pavilion, in the Exhibition grounds, where they are erecting a good showing of electrical generators, one driven by a large gas engine, a Westinghouse car, and other plant of their manufacture.

The Pavilions.

We may here conveniently mention that on "Machinery Street" there are also several other pavilions of an interesting character. One contains a large variety of machine tools by Messrs. Selig, Sonnenthal & Co., who have an equally good exhibit of similar machines in the Machinery Hall. A pavilion has been erected by the Bullard Machine Tool Company, of America, where, under the very pushing supervision of Mr. E. P. Bullard, jun., or other responsible official, actual work is to be done for Glasgow folks during the run of the Exhibition, just to show them what sort of work the Bullard vertical boring and turning mills (which are made in various sizes from 30 in. to 102 in.) can be made to turn out. Then, on the opposite side of the way, there is a like pavilion being equipped by the British Schuckert Electric Company, where their generators, motors, and so forth will be in operation, and a few yards away Messrs. Chas. Churchill & Co. have their own special house, in which a large variety of their machine tools are in evidence. This firm is further represented in the Machinery Hall. Also in the same street Messrs. E. Green & Son have an erection containing a large exhibit of their well-known economisers.

At the time of our visit, about a fortnight ago, these pavilions, with one or two exceptions, were in a state of comparative chaos, and when one bears in mind that all the heavy machinery has had to be conveyed up a steep, rough, and winding road, with very scant facilities, one has at once one explanation of their backwardness. In the Machinery Hall itself, the surprise is that things are so complete, for heavy parts have had to be brought in without any assistance in the way of overhead crane—a facility which one would have thought exhibitors might have been allowed.

At a later stage we shall be going into the electrical and engineering machinery and apparatus in more general and descriptive detail; our object at the present moment is to run roughly over the ground, indicating the chief features at the different stands.

The Boiler House and Generating Plant.

The great boiler house with its very interesting object lesson of up-to-date methods of steam raising, with Lancashire, marine and water-tube types, and with various systems of stoking, and so forth, contains four Penman Lancashire, two Babcock water-tube and one marine, one of the "Economic" type by Messrs. Davey-Paxman, and two Stirling water-tube boilers. These supply steam for driving a number of electric generators, which are railed off from the exhibits in the near corner of the Machinery Hall, and for steam driving where employed on the different stands, the steam piping being laid under the flooring. Only about half of the generators were erected when we saw them, and the others were engaging the attention of busy groups of workmen. Thus the lighting of the Hall and the power supply for motor driving on the different stands were incomplete. Doubtless by this time all these things have been remedied. Willans engines are to be seen driving Crompton and Schuckert dynamos, Robey engines are direct-coupled to Mavor and Coulson and Scott & Mountain engines. There is a Ruston-Proctor engine and dynamo, a Scott & Mountain ditto, an Alley & MacLellan engine driving a Mavor & Coulson generator, a Browett-Lindley running an Edison & Swan, a Belliss & Morcom driving a Bruce Peebles, a Sissons engine coupled to a Clark-Chapman generator, and a Davey-Paxman driving an E.C.C. dynamo. Messrs. D. Bruce Peebles have furnished in connection with these a balancer for dealing with 100 amperes. The main switchboard has been erected by Messrs. Kelvin & James White, Limited. Arc and incandescent electric lighting are very largely employed throughout the Exhibition premises, and a description of the arrangements has already appeared in the Electrical Review* in the report of a lecture on "The Engineering and Electrical Work of the Glasgow Exhibition," delivered by Mr. Thomas Young, the engineer and electrician to the Exhibition. The greater part of the lighting of the grounds is done by means of incandescent and oil gas, but at one point there are 90 Brockie-Pell arcs in service, and arcs of the same type and Zurich and Ediswan incandescents are employed for a large number of the buildings.

The Machinery Hall.

Turning now to the exhibits, the general arrangement of the Hall is excellent. Entering from the grounds one gets at once a good view of the entire Hall, and convenient roomy balconies are arranged the whole length of the building, from which one can make a rough acquaintance with the exhibits on either side. Staircases are provided, by which one may descend to whichever side one chooses, for the purpose of coming to close quarters with things. On the left one finds a variety of stands, at which are illustrated general engineering materials and fittings, and a number of gas engine exhibits; on the right, for the most part, are large electrical machinery exhibits, iron and steel work, and beautifully finished English locomotives, which present a quite imposing appearance; between these rows being a very large number of exhibits of English and American machine tools.

We will first take a glance on the left of the hall, where are some unimportant stands, so far as mere bulk is concerned, but no doubt important from an engineering point of view. Mr. C. J. W. Barwell, of Birmingham, has an exhibit of brass and copper tubes for electricians and others. Messrs. H. Wiggin & Co., Limited, of Birmingham, have a variety of things, including files for electrical engineers. Messrs. J. Edelsten & Son, of Warrington, show Lancashire tools and "Magna Charta" files. Messrs. W. Beardmore and Co., of Govan, have an interesting wall exhibit of models of many types of merchant steamers, among which are cable steamers built for the Eastern Telegraph Company. Mr. J. A. Rudd, of Glasgow, has a show case of electrical engineering apparatus, and he also exhibits various types of cables, including telephone cable with rubber or paper insulations, also vulcanised rubber concentric cables, paper telegraph cables, &c. A wall show case by the Cambridge Scientific Instrument Company has a neat exhibit of resistance boxes, electrical measuring instruments, Duddell's oscillograph, the Callender recorder, and many other interesting things. Feed water filters and "Reliance" feed regulators are shown by the Boothman Patent Filter Syndicate. The Blast Furnace Power Syndicate have a showing of models, &c., of the Thwaite-Gardner system of utilising blast furnace gases. Messrs. Wallach Bros. are represented by various asbestos and other like goods and apparatus whose object is to prevent accidents in industrial occupations. The Carbon Cement Company, of Glasgow, show their boiler and pipe coverings and insulating materials; and Messrs. Reid M'Farlane and Co., who have covered all boilers and pipes in the Exhibition with their non-conducting materials, have a stand where these are to be seen. Drawings of mechanical stokers, &c., are exhibited by Mr. Thomas Henderson, of Liverpool. Engine and boiler fittings are shown by Messrs. Hunt & Mitton, of Birmingham, and by Mr. J. M. Reid, of Glasgow. The Scottish Aluminium Company, who have loaned the overhead aluminium conductor employed in connection with the lighting of part of the grounds, have a variety of aluminium articles, together with specimens of jointings. Messrs. Le Carbone show their batteries and other accessories with which the trade is familiar. Messrs. G. & J. Weir have an attractive and noteworthy exhibit in one corner of the Hall, where they show their feed pumps for electric light stations, also their well-known pumps for other purposes.

There is a good showing of belting of different kinds. Messrs. John Tullis & Son, Limited, exhibit their leather, link, hide, hair and cotton beltings; Messrs. Balderston & Co. show Hoyt's leather belting for machine driving; and Messrs. R. and J. Dick also show driving belts. Mr. James Hendry, one of whose patent laminated leather belts is employed for driving the main shaft from a motor situated on Messrs. Bruce Peebles's stand, has a stand for his belting and also for his leather-covered pulleys, which we understand are now coming to the front; in fact, some are doing service at the Exhibition. The Frictionless Engine Packing Company also show different kinds of beltings and packing.

The General Electric Company, Limited, whose thousand and one items covering pretty well the whole of the electrical industry are known to everyone, has one exhibit at which are to be found many specimens representative of the wide field covered by its manufactures, and in another part of the hall one of its Peel-Hawkins multipolar generators is to be seen driven by a Davey-Paxman (Peache) high speed engine. Messrs. W. McGeoch & Co. have on view an excellent variety of electric lighting fittings both for ships and houses, which make quite a neat showing; also Wilson's motor starting switch, Johnson and Phillips's "Ark" lamps and cables, "Sunbeam" incandescent lamps, and Nalder's measuring instruments. Near at hand we came across the stand of Messrs. Morris, Warden & Co., of Glasgow, who have practically three different exhibits under their supervision, one showing on behalf of the British Insulated Wire Company, the Mordey-Fricker electricity meter, and a variety of cables for electric light, telephone, traction, and power work, also joint boxes, conduits, section pillars, and trolley line equipment; another showing a good assortment of batteries by the Tudor Accumulator Company, together with a Bruce Peebles motor-generator, and a third showing Brockie-Pell arc lamps as used in the lighting of the Exhibition buildings.

A stand which will doubtless attract a good deal of attention is that of the Ericsson Bell Telephone Company. Specimens of the instruments supplied in connection with the Glasgow municipal telephone service are to be seen here, and the stand is during the run of the Exhibition connected to the Corporation service, which it is now generally known is in working. The company also has on view a quantity of copper wires for telephone purposes, and strips for dynamos, &c. The Clay Cross fuel economiser is exhibited by the Clay Cross Company.

An interesting machine is shown by Messrs. Clarke, Steavenson and Co., Limited, of Barnsley. It is known as Clarke's patent electrical coal-cutting disc machine, and was introduced by the firm three or four years ago, since when over 80 of the machines have been set to work in Great Britain. Two types of the machine are made, one adapted for thick seam work, and the other is a low type of machine arranged for cutting in thin seams, where the available room does not exceed 20 in. Lifts (electric and hydraulic) are represented at the stand of Mr. John Bennie.

* Electrical Review, February 8th, 1901, p. 229.

Messrs. Reavell & Co., Limited, show their double-crank engine, directly coupled to a 50-KW. two-phase Fowler-Hall dynamo (1,200 volts, 500 revolutions per minute). Compressors driven by electric motor and belts are also to be seen here, a 5-H.P. Laurence-Scott motor doing service for the electrically-driven one. The well-known plant of the Wheeler Condensing Company has a stand devoted to it, and a water-tube boiler is shown by Mr. George Sinclair, of Leith. An electrically-driven hydro-extractor is shown by Messrs. Thomas Broadbent & Sons, of Huddersfield, and a feed heater, filter pump evaporator, and small gas engine by Messrs. Wilcox Bros., of Sunderland.

Those who are interesting themselves with coal-handling plants, will find the Temperley Transporter Company's model exhibit worth studying. Printing by electricity without ink, is being carried on at the stand of Messrs. John Reid & Son, and Lundell and Crocker Wheeler electric motors are to be found at printing machinery stands in the vicinity.

One of the most commanding and attractive showings of electrical machinery is that by Messrs. D. Bruce Peebles & Co., whose push and enterprise have made this firm stand out so prominently among English manufacturers during the past few years. Everything shown is quite faultless so far as beautiful finish and general appearance are concerned, and we have no doubt that when we enter into the matter in more detail later on much the same comment will have to be made regarding the construction and working of the different machines. A 150-B.H.P. motor drives the main shaft in the Machinery Hall, a motor is shown driving a Gwynne double-throw pump; there is also a 60-B.H.P. enclosed motor for mining work, a motor-driven capstan, a 350-KW. Peebles dynamo, a 350-B.H.P. Peebles-Belliss generating set, and sundry other machines, and very shortly the Peebles-Willans train lighting plant will be placed in position.

GAS ENGINES.

Next the visitor comes upon a number of excellent gas engine exhibits, to which we may refer fully at a later date. We may, however, mention them briefly here. The National Gas Engine Company show running a "V" type 49-I.H.P. engine, running at 180 revolutions, a "P" type 19-I.H.P., running at 200 revolutions, an "M" type 9½-I.H.P. (230 revolutions), an engine of the "L E" type, 6½ I.H.P., combined with a direct-driven dynamo for 50 lights. These engines are in all cases fitted with the National patent starting arrangements and specialities. The Stockport gas engines are exhibited by Messrs. J. E. H. Andrew & Co., Limited; they have a 7½-H.P. engine which drives a small dynamo for lighting the stand with enclosed arcs and incandescents, also a 70-B.H.P. model of large power gas engines fitted with their latest improvements, including their patent "automatic" self-starter.

Messrs. Pollock, Whyte & Waddell, of Johnstone, are also running several gas and oil engines. The Campbell Gas Engine Company show a 16-B.H.P. electrical type gas engine, of a new design, and representing their latest model. The timing valve is of a new design containing a novel arrangement calculated to increase its efficiency. The fly-wheel is of great weight and large diameter, and is supported by an outside bearing, and the makers guarantee a variation in speed not exceeding 2 per cent. Their other exhibits consist of a 4 B.H.P. and 13 B.H.P. oil engines, the former driving a 4 in. × 6 in. three-throw ram horizontal pump, which forces the water through the jackets of the engines, and thence back to the tank. The oil engines are, like the gas engine, the latest specimens of Campbell manufacture and simplicity of design and strength of gearing are claimed as special attributes. The horizontal ram pump is a specimen in small size of a class of pumps which they are supplying to Scotch collieries. The Campbell Company have for some years combined with the gas and oil engine business the manufacture of pumps, and this branch is now being well nursed, with the result that they are at present supplying pumps for electrical drive in some of the largest Scotch collieries.

A new model of the "Forward" Otto gas engine is shown by the Forward Engineering Company. It is of 11 B.H.P., and drives a small dynamo (by Chamberlain & Hookham) the whole constituting a model private lighting installation. The "Acme" gas and oil engines are also in evidence, being shown by the Acme Manufacturing Company, who also have a 40-B.H.P. gas engine fitted with their improved self-starting apparatus for supplying power for the water chute in the Exhibition grounds. A large stand is devoted to a number of "Otto" gas and oil engines exhibited by Messrs. Crossley Bros. The "Express" silent gas engine is to be found at the stand of Messrs. Furnival & Co., who are the sole makers. The Westinghouse gas engine exhibit, as we have already stated, is to be seen working in the company's own pavilion.

(To be continued.)

LORD LONDONDERRY AND THE TELEGRAPHISTS.

A REJOINDER.

BY CHAS. H. GARLAND.

To recommend silence to an opponent in discussion is to invite, if not to merit, the retort personal. Yet the first effect upon me of reading the Postmaster-General's reply to the deputation of members of Parliament who waited upon him in June, 1900, was to recall to the foreground of my memory a line of Goethe which had reposed in unheeded seclusion since the days of my German classes.

"*Sobald man spricht, beginnt man schon zu irren.*"

For some years past the Postal Authorities have entrenched themselves behind the Tweedmouth Committee's recommendations, and consistently refused to be drawn into a discussion of the points which were dealt with by that body. The silence, if not justifiable, was, at least, impregnable. The recent breach of that silence, which was published in the ELECTRICAL REVIEW of May 3rd, certainly does not share in the same character. After making due allowance for the difference in point of view which must necessarily exist between administrative officers and staff, there still remain some matters of fact upon which the Postmaster-General would seem to be lamentably misinformed.

The introductory paragraphs even are unfortunate in their conception, and leave one at the initial stage of perusal with the conviction that they are excuses rather than reasons. The reference to the recommendations of the Tweedmouth Committee, as "recently arrived at," is surely not seriously meant. The report of the Tweedmouth Committee was published in March, 1897, and referred to evidence taken during 1895 and 1896, so that the conditions with which it deals are at least five years old. During these five years the economic and social progress of the country has been proceeding at an accelerated pace, and the environment of the employés has greatly changed. House rents have been rising rapidly, and it is possible to prove by the official market reports that the purchasing power of money has decreased from 15 to 20 per cent. during the last two years. This decrease of purchasing power relates more especially to the necessaries of life. In the face of such facts as these, five years can hardly be considered a short period. In considering such questions as the adequacy of salaries, the value of time is strictly relative to the rate of national progress. "The opportunity is not a favourable one for proposing further expenditure on salaries" because of "the general financial condition of the country at the present moment." Assuming the case to be made out, this is hardly a reason for withholding reform. The delay of 10 months in replying to the deputation has been due to Lord Londonderry's desire to find a remedy for the admitted stagnation of promotion. In a letter dated January 23rd, 1901, addressed to Sir A. K. Rollit, M.P., Sir Geo. Murray apologised for the delay in answering the deputation. "The delay," he says, "has been due solely to our trying to find some measure which we could take to relieve the stagnation of promotion about which the telegraphists complain. At present, I am sorry to say, we have not been successful." The assumption that a case was made out concerning the stagnation of promotion, and that the postal authorities were seeking a remedy, is therefore perfectly justified. But after 10 months' search for a remedy, we are told that the "general financial position of the country" prevents. As a digression, it would be interesting to speculate how far Sir Michael Hicks-Beach has coerced Lord Londonderry in order to bring him to this pass. But withstanding the temptation of a peep into Cabinet secrets, it is necessary to note how this plea presents itself to telegraphists. The men are all taxpayers, and share in common with the other taxpayers of the country the increased burdens of taxation. They have demonstrated their practical patriotism by volunteering in large numbers for service at the front, and over 300 of them have borne the rigours of the South African campaign. They have contributed largely and readily to that form of voluntary taxation which consists in supporting the widows and orphans of the fallen. Even now periodical contributions are made to the same end. It therefore presents itself to them as a most unjust act to delay the remedy to their admitted grievances, and thus practically submit them to a further and most oppressive indirect tax upon their depleted incomes. I hope Lord Londonderry will consider seriously how far efficiency and patriotism are fostered by the feelings which inevitably result from treatment that is so viewed by the workers. That he is fully alive to the damage caused by unrest, is proved by his recent reply to Mr. Thos. Bayley, M.P., when he urged, as one of his reasons for refusing an inquiry, the injury which might result to efficiency from the unrest occasioned by an investigation. (House of Commons, April 25th, 1901.)

Leaving the general questions, let us turn to the details. Here we find his Lordship is equally unhappy. The following passage contains so many errors that it is worthy of close and careful consideration:—

"Several of the speakers," says the Postmaster-General, "complained of the insufficiency of the existing maximum (namely, £160) for the rank and file at the Central Telegraph Office, and it was contended by at least two members that the maximum which was attainable in the ordinary course had been reduced in a manner which constituted a breach of faith with the men. If this could have been established, Lord Londonderry would not, of course, have allowed any finding of the Tweedmouth Committee to stand in the way of a reconsideration of the matter. He is satisfied, however, that there is no ground for any such charge. The class of Overseers and Senior Telegraphists (formerly called Senior Telegraphists) which is immediately above the rank and file, and which rises to a maximum of £190, has always been a distinct class superior to the general body; and promotion to it has always been dependent on the occurrence of vacancies. The allegation that men were entitled to rise to it as a matter of course, and without waiting for vacancies, was never true at any time; and the conditions under which promotion to it is now obtained are precisely the same as they always have been, namely, good conduct and competence to perform superior duties."

The claim made by the telegraphists, and very clearly expressed by Sir Albert Rollit and Mr. W. C. Steadman, was briefly this: From 1881 to 1890 the papers issued to candidates for the telegraph service by the Civil Service Commissioners contained the following words:—

"NOTE.—The Civil Service Commissioners are authorised by the Postmaster-General to append the following notices." After an enumeration of the earlier stages the notice continues:—"After a

year at 16s. a week, to advance to £45 a year, rising by £5 a year to £100, *with a prospect of attaining* £190." For nearly 10 years there was no sign that this promise would not be carried out. Telegraphists, as operators, with no further qualification than manipulative ability, regular attendance, and good conduct, reached the maximum of £190 after about 21 to 23 years. Then a policy commenced which has since been persistently pursued. Little by little it was sought by the authorities to sever the senior class from the operating body. The estimates used to contain under a heading of "General Body," the classes of "Senior Telegraphists," "First-Class Telegraphists," and "Second-Class Telegraphists." As signifying the trend of the new policy the heading "General Body" was in 1890 removed from its position above the class of "Senior Telegraphists." The few supervising duties performed by the Senior class for relief purposes, and which were not proper to them as a class, formed the excuse for calling them a "supervising class," and the obvious intention of the authorities was to so differentiate the duties and designation of the senior telegraphists as to cut them off completely from the General Body. In 1892 a technical examination was suddenly introduced as a qualification for entry into the Senior Class. This was removed as the result of evidence given by me before the Duke of Norfolk in 1897. But still the policy of the authorities was pursued, and they have now nearly succeeded in converting the Senior Class into what they have called it, *i.e.*, a supervising class. But a number of survivals from the period 1881—90 bear witness to the original conditions. By the pursuance of the policy described the Department avoided compliance with what should have been the honest interpretation of the Tweedmouth Committee's recommendation on classification:—"Wherever in the case of officers not performing work of supervision classification exists it should be abolished." The Senior class ought not to be a supervising class.* It was created as a part of the operator's scale, and promised to candidates by the Civil Service Commissioners. The "breach of faith" consists in altering the duties of this class in such a manner as to shut it off from those who received the promise. The statement that the "senior class has always been a distinct class superior to the general body" is untrue, as a reference to the classification in the estimates will show. "The allegation that men were entitled to rise to it as a matter of course, and without waiting for vacancies" has never to my knowledge been made. The position is this: during the earlier years of the Fawcett scheme, before the system of arbitrary classification had reached its inevitable breakdown, long waits for vacancies were unknown, Telegraphists could, and did, reach the maximum of £190 promised them; but now that the system has broken down it is absolutely impossible for telegraphists to realise the prospect solemnly promised to them by the Civil Service Commissioners in the name of Postmaster-General. To argue that this is the inevitable outcome of the present system of promotion is simply to add one more to the already overwhelming number of reasons for reforming the system. A promise has been made, it is necessary that it should be fulfilled. It is impossible to escape by Mr. Balfour's sophism, for hundreds of telegraphists are clamouring for its fulfilment.

The final statement of the paragraph will be best answered by placing it in parallel with another statement by the highest authority on the practice of promotion in the Central Telegraph Office:—

Lord Londonderry, April 25th, 1901.	Sir H. C. Fischer, Controller, Central Telegraph Office, January 10th, 1896.
"The conditions under which promotion to it (the Senior Class) is now obtained are precisely the same as they always have been, namely, *good conduct and competence to perform superior duties.*"	"*Ordinary manipulative ability, combined with regular attendance and good conduct*, were considered sufficient qualifications for promotion to the Senior Class."

If the Postmaster-General is so ill-informed in matters of fact, it is not surprising that the matters of opinion are so far astray. But we have not yet reached the end. "Telegraphists," we are told, "receive a considerable number of appointments on the engineering staff." True; telegraphists frequently succeed in the examinations for these posts, but what has this to do with the "stagnation of promotion" which is under consideration? To get a position on the engineering staff a man must be within certain limits of age which are long past ere the grievance of stagnated promotion affects him. The men suffering from stagnated promotion are men with 21 to 26 years' service, and their ages range from 35 to 40. Is there a case of examination for the engineering branch where the upper age limit is 35? If not, the remedy hardly promises to be effective. "It is, moreover, always open to them," continues the noble marquis, "to acquire a competent knowledge of postal duties, and so qualify themselves for promotion on either side." A man in the C.T.O. with a competent knowledge of postal duties applied to take his turn for promotion on the postal side, and he was informed that he had no claim to promotion in that branch because he was a telegraphist. This appears to be the rule throughout the country. The staffs are mixed, but the superior appointments are kept quite separate. Lord Londonderry's statement may be founded on some new rule that it is his intention to issue, in any other case nothing to justify it is known by the telegraphists. But, really, the earlier parts of the document tempt us rather to regard the statement as erroneous.

Such are a few of the faults which appear in the Postmaster-General's pronouncement when viewed from the point of view of the telegraphist. "Unrest," said Lord Londonderry's representative in the Commons, "unrest is detrimental to efficiency." The fact to be dealt with is this: There are hundreds of men in the telegraph service who honestly believe they have had their legitimate prospects filched from them by a deliberately planned and long-continued policy of the Postal Department. The facts seem to me to support that view. Yet, in reply to their complaints, they are met with academic quibbles and attempted justification of the policy. The evidence and logic of the departmental pronouncements is faulty to a degree. Feeling that it is useless to trust longer to Postal justice, the men ask for a Parliamentary Committee of Inquiry, and, providing proper guarantees are given of its impartiality, they promise to abide by its findings. At present the unrest is of a most pronounced character. For the sake of the efficiency of the service, Lord Londonderry would be wise to take other measures than he has yet tried, to allay it. His latest pronouncement has gone far to increase it.

* Mr. Fawcett in his letter to the Treasury, June 13th, 1881, which was adopted, proposed that the "first scale would be paid where duties of the highest quality have to be performed. . . . Duties of high quality but not of the highest quality, would be paid for at the second scale." The "first scale" was the scale reaching £190. The latest paper issued by the Civil Service Commissioners says that "officers who obtain a certificate of excellence of conduct and of ability to perform the highest duties of their class, may rise to a maximum of £160 a year." So it is obvious that the price proposed to-day is £30 less than the price proposed by Mr. Fawcett for duties of the "highest quality." It is specially noteworthy that Mr. Fawcett in the next paragraph refers to the "superintendents and assistant superintendents ranking above the general body," thus dividing his staff into two parts: a "general body" which includes 'seniors," and another part ranking above the "general body." Lord Londonderry says senior telegraphists have "always been a distinct class superior to the general body."

REVERSIBLE BOOSTERS AND SECONDARY BATTERIES.

Mr. J. S. Highfield's paper on "Storage Batteries in Electric Power Stations, Controlled by Reversible Boosters" brought the Institution of Electrical Engineers back, on Thursday of last week, to central station work. The ingenious combination of battery, main booster, and exciter received its due proportion of praise, and the discussion showed how glad station engineers were to get rid of regulating cells—an endless source of worry and trouble. One or two of the speakers harked back to the older theories of the employment of storage batteries in central station supply, but, as Mr. Highfield put it, his contention was that whether the power station has simply to deal with a lighting load, or is of the composite type, combining lighting and traction supply, a storage battery is a most useful auxiliary, provided a booster is added to it to maintain a constant line pressure and the apparatus is automatic in its action. It was demonstrated that the high efficiency attained is due to the periods of charge and discharge alternating with one another at short intervals, by which means the battery was worked very largely as a "gas battery," and the chemical changes did not sink deeply into the materials of which the plates were composed. It is not too much to say that the addition of battery and booster should do for direct current stations what parallel running has effected for those operating on the alternating current supply system.

Mr. Shoolbred thought that the numerous moving parts of such a booster would go against it, and preferred to use "half pressure machines." He considered that batteries were of most use in small stations, while in traction works they should take off the excessive peaks in the tram loads and leave a more uniform load for the generators to deal with. The grading of generating plant was an important matter. Mr. Grindle spoke feelingly of the unsatisfactory character of regulating cells, and considered Mr. Highfield's means the most perfect yet designed, while maintenance would be greatly assisted as cells were put in their most advantageous position by being saved from running down. By the booster, a battery was practically always worked on the top of the curve. This opinion was backed by Mr. Patchell, who said that regulator cells were those in a battery which always gave trouble. He had used motor-generators hand regulated to get rid of such cells, and since had practically ceased to know what trouble was. Usually the main difficulty was with the cells between the charge and discharge stops on the regulator switch. He demonstrated the economy of working with a reversible booster, as 50 cells would suffice instead of 60 where regulating cells were added. The cost of the leads and additional cells outweighed the cost of a booster, and, further, maintenance charges had

only to be calculated on 50 cells in such a case instead of on 60. The efficiencies given were well within the mark; in a practical example 26 per cent. of the plant only ran six hours a day, and earned but 4 per cent. of the money revenue. Stations like Chelsea, which were originally intended to show what could be done with batteries, were at the bottom of the list as regards their use, but decent results could be obtained with modern plant. Mr. Wordingham had always found it difficult to know when to charge a battery, as it was so handy that an engineer wanted to use it throughout the 24 hours. That was exactly what Mr. Highfield did, and filled in the charge at odd moments. It really seemed as if all the difficulties had been solved by the author.

Mr. H. M. Sayers had been attracted by the paper as soon as he saw what Mr. Highfield had been doing, for he had found paper solutions, but not working solutions, to the problem of lighting from a battery in combined stations with the charging done from the traction sets. A full ½d. could be knocked off the costs by such a method of working. Experience had taught him that tramway plant would be greatly advantaged by auxiliary secondary batteries, and the combination with the reversed polarity booster made it a practical thing. Peaks of 390 amperes often occurred with average loads of 90 amperes and 240 amperes on 70 amperes average. Peaks were often quite periodical; on a small line with single track and turn-outs, a multiplication of cars could not cut down the peaks, but the Highfield arrangement would hold there.

Prof. Ernest Wilson described Siemens & Halske's device for automatically boosting, and pointed out its defects. Col. Crompton stated that Mr. Chamen had worked out to his order some eight years ago a similar arrangement to Mr. Highfield's, which was patented with the title of an "up-down" dynamo. This called up reminiscences of the fights over "Systems" in which the speaker took such a prominent part 12 to 7 or 8 years ago, and how a good deal of incredulity was shown by a large section of the then audiences to the proposition of using a battery in parallel with the generators. Batteries worked well or badly owing to the men who manage them differing so much. Every man is not built to run a battery. With the right men it pays to instal a much larger proportion of batteries. The efficiency could be kept up to 81 to 84 per cent. for months, if not years, together. At Kensington Court he had insisted for a long period on putting down 14 per cent. as the depreciation of the battery.

Mr. Trotter had found watching the switchboard at St. Helens station very interesting, and the battery room was really a treat owing to a forest of leads not being in evidence. The St. Helens figures seemed low for the number of cars on the line. Mr. Esson thought that the table of battery-power, if analysed, would show that in the smaller stations the battery-power was comparatively larger. Thus in stations below 500 KW. the factor was ·25; in those 500 to 1,500 it was ·125; 1,500 to 5,000 was ·1, and above 5,000 KW. ·04 for ratio of battery to steam plant in kilowatts, and this he considered showed that "accumulators were only of use in toy stations." Mr. Esson then went into a detailed argument based on the Willans $a + b$ KW. law, and gave the cost of running as 4s. 7d. + (·22d. × KW.-hrs.), or 4s. 7d. as the cost of running per hour and under ½d. per KW.-hr. of output. Mr. E. K. Scott referred to the Continental use of batteries and boosters, and Mr. S. F. Walker accounted for the high battery efficiency Mr. Highfield claimed by his getting rid of a lot of the work in the plates themselves.

Mr. Highfield replied by objecting to the statement that as stations grow larger the use of accumulators practically vanishes. Shifts of men might not be saved, a large number of units enabled the load on the engines to be kept constant, but the load could only be kept constant on the boilers by having a battery. The accumulator need only deal with one-fourth to one-sixth of the peak run. The high efficiency of the battery was not due to the use of the booster, but to the immediate succession of charge and discharge. He demonstrated how poorly the Siemens and Halske arrangement would look when the load outgoing dropped, and closed an interesting debate by enforcing the necessity for the booster only boosting when a boost was required.

SMOKE AND GRIT FROM ELECTRIC AND FACTORY CHIMNEYS.

CAN SMOKE BE RECORDED, AND PRACTICALLY DIMINISHED?

BY A MEM.I.C.E.

I.

THE question of the diminution of smoke is one which has been before the English public for hundreds of years. As early as 1257 the Queen of Henry III. was obliged to withdraw from the town of Dunstable, because the smoke from the "sea coal," as it was called, was so objectionable to her. Newcastle coal was then slowly coming into use as a fuel, but in 1306 an Act of Parliament was passed peremptorily forbidding it to be burnt, on account of the smoke produced. Such a stringent measure could not be permanently enforced. As the supply of wood in England became gradually exhausted, the people were compelled, through scarcity of fuel, again to have recourse to coal, but it is worthy of note that in the reign of Elizabeth an order in Council forbade coal fires while Parliament was sitting, lest the smoke should prove injurious to the health of the members!

At the present time some electric light and power stations in London and elsewhere are certainly among the worst offenders, and seem to aim at showing the public how much black smoke they can emit from their many chimneys, and how few efforts they make to diminish it. This is especially the case with stations where Welsh coal is not burnt, and at certain times of day, towards evening, when the load on the boilers and engines is greatest. Many factory chimneys are also great offenders, especially after stoking, but they are probably not quite so bad as the electric stations with their water-tube boilers, hard firing, and mechanical draught, particularly when they burn small Newcastle or Midland coal. The greater the number of boiler furnaces discharging their products into any one chimney, the greater generally will be the duration and intensity of the smoke, because with many boilers one fire or another is almost continually being stoked, and it is immediately after this operation that the blackest smoke is generally given out.

We shall best approach our subject by considering—

I. The case of a chimney that smokes well, and there are many such.

II. The method of representing on paper the intensity and duration of smoke, say every five minutes during eight hours; and

III. The best way of diminishing the evil, at least to a certain extent.

1. The law provides a fine for black smoke of a certain duration, but it is left to the magistrate to say if it constitutes a nuisance or not. The owner has often to pay, but he generally does nothing afterwards, and does not seem to care. Taking the case of a given chimney with one boiler, emitting, after stoking, black smoke for 5, 10, or even 20 minutes. As thus stated, the case is, perhaps, often sufficient for a smoke inspector, his witnesses, and the law, but it is not altogether satisfactory. Observations should be made over a much longer time, the differing intensity of the smoke noted, and its duration, to get an average.

2. But to represent these on paper, we must know, say, during 10 hours continuously, how often such black smoke has appeared, and its duration in minutes. To determine its varying intensity, the best way is to adopt a smoke scale of five degrees, black or grey, No. 5 being thick black smoke, No. 4, black smoke, No. 3, dark grey, No. 2, light grey, and No. 1, very light transparent grey. Observations should be made by trained men every five minutes, or better, every 2½ minutes, with five pictures representing these five different scales of intensity always before them, to compare them with the colour of the smoke at the top of the chimney. In this way a careful observer, or, better, two observers, will arrive at something very near the truth, and will obtain results which can easily be plotted on paper on a time basis. Two or three inches horizontally may represent, say, one hour, while five vertical divisions mark the five different degrees of smoke intensity. The writer has had many observations plotted in this way, sometimes with, and sometimes without,

a nominal smoke consumer attached to the boiler. This is done with a view to get the time and intensity of varying degrees of smoke coming from a given chimney on a given day, and to put the record on paper in a practical way, so that an engineer or a magistrate can understand it. Any intelligent person with a little practice can do this. There are many nominal smoke-consuming patents, but few engineers have been at the trouble to plot the results every two and a half minutes during an eight hours' test, first with and then without the given apparatus, and this with the same stoker and the same smoky coal. Some few smoke-consuming apparatus have gone through this test satisfactorily.

In order to determine what tends to produce the spasmodic emissions of black smoke, the time of stoking may also be plotted on the time base, after plotting the degree of blackness from a chimney with one boiler. It will soon be discovered that it is always after stoking each fire that the worst smoke occurs. Poking and stirring black fires also give smoke, but not quite so bad as that produced by stoking. A few careful observers who live in the neighbourhood of smoky chimneys should draw up and send in such a diagram to the local authorities, if they consider the smoke sufficient in their opinion to cause a nuisance.

3. We will now assume that we have got some practical facts as to the intensity and duration of the smoke from a certain chimney. If proved before a magistrate to his satisfaction the owner may be fined. Then he pays; but he probably has no intention of going to any trouble or expense to diminish the smoke. This is an ordinary case representing some electric light and power stations, where they have perhaps 20 to 40 boilers, which are often being stoked, especially at busy times, towards evening, &c. The net result is a practical deadlock between the owners and the law, and may be represented by the following imaginary conversation:—

(Factory chimney in the distance, seen to be smoking badly.)

Onlooker (to owner): "Chimney smoking badly again?"

Owner (sullenly): "Suppose so. Anyhow the smoke inspector and magistrate say so. They've fined me. Don't care!" Thinks to himself: "All the same, I should like an independent opinion on my chimney smoking, if it costs nothing, but I hate patents, smoke inspectors, inventors and spending money."

Result: Owner does nothing, and is fined again and again, and irritated. So the war goes on. A few independent experiments, with patentees and inspectors well out of the way, might probably convince him that some remedy is possible.

The question is, what should be done to enforce steps towards improvements? It is not for the inspector to mention any smokeless system, or any names, and the owner hesitates to do anything until he is perhaps fined again. The engineer of an electric station has probably no permission to spend money. Whether smoke is really consumed or not, there is little or no money to gain in suppressing it. If, however, combustion can be improved, the right amount of air admitted in the right way, and the gases analysed, the result will be an economy of fuel which should soon pay for the money outlay. The best practical way of getting over the present deadlock between owner, magistrate, and smoke inspector is probably to appoint a committee for testing smoke-preventing appliances under, say, the auspices of the Institution of Civil Engineers, Mechanical Engineers, or Electrical Engineers, or, better still, a combination of the three. The makers would probably put their apparatus at the disposal of such an independent body of experts. At present, the magistrate enforces the law, and the owner often does not know what to do to improve some of his smoke away.

The writer is of opinion that there are many ways of diminishing largely the degree and duration of the worst smoke (No. 5) from a factory or electric light station chimney, by letting in more air through the doors, over the bridge, and over the grate; forming a firebrick combustion chamber, with an air inlet behind the bridge; and also, if possible, by heating the air for these various inlets. More care in stoking, and a smaller quantity of fuel put on at a time, should also be enforced. The stoker in the stoke-hole should be able to see the top of the chimney complained of, and if possible without going outside, by a window or opening in the roof. The gases from the boiler furnaces should be analysed to determine their percentage of CO, CO_2, and O. The type of boiler and boiler setting, the draught, the grate, and its distance from the boiler surfaces, have each their influence on the smoke. But the quality and size of the coal used and the skill of the stoker are important factors, and especially the rate of coal burnt per square foot of grate surface per hour, whether 5 lbs. or 30 lbs. or more, and the quantity thrown on each time. The smaller the amount of fresh coal fired at a time, the less will be the smoke. The thickness of fuel on the grate should be kept uniform as far as possible. Each case must be decided on its merits, and boiler makers and boiler insurance companies may often be consulted with profit. There are many cases on record where, by introducing such improvements, the time and the intensity of the smoke have been largely diminished.

With this object two grates are often used in the United States.

Young electrical engineers at the different stations do not seem to have studied the question of the diminution of smoke with a given coal, boiler, grate and draught. Perhaps they will say they have no time, but with attention and care, and making the stokers interested, much could be done at small expense. Stokers should be carefully trained and looked after, and prizes for diminishing the smoke should be offered. Coke, anthracite, and gas can all be burnt under boilers, and are smokeless, but they are not often practically applicable, on account of their expense, as compared with bituminous coal.

Municipal chimneys, and those of Government factories, in England and on the Continent, are often the worst offenders, and it is they who ought to show the right way to produce the minimum of smoke. Improvements to do away with black smoke would probably be better enforced on the spot, through inspectors of boiler associations and other experts, to avoid unreasonable interference.

(To be continued.)

CURRENT SPECIFICATIONS.

LXII.—DUBLIN EXTENSIONS.

Summary.

Extent of Contract.—Five sections of the work of equipping the new system are specified, viz., M, main switchboards; N, sub-station switchboards; O, transformers; P, arc lamps; Q, arc lamp pillars.

System in Use.—The plant is for use on a three-phase circuit having 5,000 volts between conductors.

Main Switchboard.—To be divided into two sections each arranged with five panels, one for 1,000-KW. alternator, one for 500-KW. alternator, two for trunk feeder mains, and one for works circuit and local use.

Type of High Tension Switch.—To consist of three contact levers, operated by one handle, with all metal parts under pressure mounted on heavy porcelain insulators, shielded by incombustible insulating partitions.

Position of Ammeters.—To be placed across a shunt fixed in series with connection from machine to neutral point, and to have specially damped needles.

Other Panels.—Synchronising apparatus as detailed to be provided, also neutral and regulating boards with instruments as specified.

Fleet Street Board.—A main switchboard on same lines as above, but with 26 panels in all to be provided at the Fleet Street distributing station.

Sub-station Switch Gear.—Nineteen high-pressure and 19 low-pressure switchboards to be provided with varying numbers of ways to suit the size and number of transformers in the different sub-stations.

Number of Transformers.—Eighty-eight single-phase transformers required in all, 76 of which will be distributed among 19 sub-stations, eight placed at Fleet Street, and four in the generating station at Pigeon House Fort.

Size of Transformers.—Twenty to be of 10-KW. output, 16 20-KW., four 30-KW., 24 40-KW., 12 50-KW., eight 60-KW., four 250-KW.

Periodicity of Circuit.—50 ~ per second.

Range of Transformation.—From a primary of 5,000 volts to a secondary of either 100, 200, or in the case of the four 250-KW., and four of the 50-KW. sizes, to 2,000 volts.

Insulation Resistance and Testing Pressure.—Not to be lower as

regards resistance than 20 ~, and to stand on primary side, a testing pressure of 10,000 volts applied for 15 minutes, and on the secondary side the 2,000 volts circuit to stand 4,000 volts, the 200 volts, 1,000 volts, and the 100-volt circuits, 500 volts.

Magnetising Watts.—Not to exceed 1 per cent. for any size.

Permissible Temperature Rise.—Not to exceed 70° F. after six hours' full load run, and transformer to stand 20 per cent. overload without injury.

Number and Type of Arc Lamps.—Five hundred to be supplied, each to be of double-carbon type, and suitable for burning a 10-ampere direct-current circuit for 32 hours without recarboning.

Method of Connection.—To be run in series of 21 lamps on a 1,070-volt circuit.

Number of Posts Required.—Four hundred, with swan-neck brackets, differing in length, so that end of overhanging bracket varies from 22 ft. to 24 ft. above ground level.

Number of Brackets.—Four hundred and eighty-one, the option of removing the 81 brackets from the existing poles to different positions in the outskirts of the city in place of supplying new ones being reserved by the Corporation.

Specified Dates of Completion.—Either eight months from date of order, or at option of contractor, one month from date buildings are ready to receive material for the switchboard work, transformers and arc lamps, and for the posts either nine months from date of order or seven months from date when engineer authorises contractor to proceed.

Specified Penalty for Late Completion.—One-quarter of 1 per cent. of contract sum for section late for first month, one-half of 1 per cent. per week for second month, three-quarters of 1 per cent. third month, and 1 per cent. per week for fourth and subsequent months.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be paid to Workmen.—Standard rates of wages to be paid, usual hours of labour observed, and none but regular tradesmen to be employed to do tradesmen's work within the city of Dublin, under penalty of 5s. per man per day.

Specified Terms of Payment.—80 *per cent.* of work executed on site as work proceeds, 10 *per cent.* three months after completion, 10 *per cent.* six months later.

Specified Period of Maintenance.—Until the final payment is made by the Corporation.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—June 3rd, 1901.

This specification is the work of Mr. Robert Hammond, M.I.C.E., the consulting electrical engineer to the Corporation of the City of Dublin, and asks for portions of the plant required for the large three-phase scheme of distribution, which has been adopted in that city after much opposition.

The experience of Dublin in electric lighting matters has not been in the past of a very happy character. The site chosen for the power house in connection with the original scheme, now some nine years old, was too small, and in an unfavourable position so far as coaling facilities were concerned, to permit of the cost of production being reduced sufficiently to make the undertaking commercially successful. The present proposal is to erect a power house at a site on the harbour, about 3 miles from the present generating station, and there to generate three-phase currents at a pressure of 5,000 volts. The greater part of this energy will be transmitted to Fleet Street, the present station, and from thence distributed to a number of sub-stations in different parts of the city. As much as possible of the existing network will be supplied from the large transformers to be installed in the Fleet Street station.

One of the most interesting technical features of the scheme lies in the employment of single-phase transformers, connected across adjacent conductors of the three-phase system, and the balancing of the entire load upon these three single-phase circuits. This will be the only place in the three kingdoms where such a course has been adopted on any extended scale; in the somewhat analogous case of Manchester, the whole of the three-phase current will be converted into direct current before passing into the distributing system.

The public lighting of the city will be carried out on an extended scale, no less than 500 arc lamps being required under the contract. These are to be of the double carbon type, 10-ampere size, and they will be run in groups of 21 lamps in series from a 1,070-volt direct-current circuit. These direct currents are supplied from motor-generators fed on the alternating current side from the high tension three-phase circuits.

The main switchboards will be of a very complete character, arranged in two complete sections, each independent of the other. This should prove a valuable safeguard against a complete breakdown in the supply to the whole of the city. Specialists in switchboard design will be much interested in the type of switch gear described.

The transformers required at the present time number 88, the sizes varying from 10 to 250 KW. All are to be arranged for use on single-phase circuits, and for a primary voltage of 5,000 volts. The secondary voltage varies, being in some cases 2,000 volts, and in others 100 or 200 volts. The general conditions are on the whole satisfactory, and they may be accepted without seriously adding to the risk of the contract.

As usual in Mr. Hammond's specifications, it is stipulated that within a reasonable period of the awarding of the contract, there shall be an official interview between the engineer and the contractor, either in London or on the site, in order to settle the details of the contract. This seems to us to be a reasonable course of action, and we think it might often be followed with advantage.

We also notice that in the clause relating to the powers of the engineer to vary work, it is stated that such alterations shall not amount to *more than 10 per cent. of the total contract sum without the consent of the contractor.*

It is stated that the contractor shall be liable for any claims which may arise under the Workmen's Compensation Act, 1897, during the continuance of the contract, which period, presumably, extends to the end of the nine months' period of maintenance. In the case of claims being made, the contractor is to be immediately notified and to have the right to conduct all necessary negotiations on the matter. We think this condition needs careful consideration, for while the contractor is distinctly liable for such accidents to his men while they are working on the contract, if he complies with the specification, and the plant has been put into beneficial use with the sanction of the engineer, we consider that the responsibility after completion rests with the engineer and not with the contractor. We suggest that, in tendering, the liabilities which are accepted under the maintenance clause be strictly defined.

As stated in the summary, the contractor must agree to pay not less than the minimum local standard rate of wages for all work done within the City of Dublin, under a penalty of 5s. per day per man for breach of this stipulation.

There is a thoroughly satisfactory arbitration clause, and since it is expressly stated that the consent of the Local Government Board to the granting of the necessary borrowing powers for raising the money has been obtained, there is likely to be keen competition for the various sections of the work.

THE ROYAL SOCIETY CONVERSAZIONE.

The first and only conversazione this year of the Royal Society was held at Burlington House on Wednesday, the 8th inst. There was not much of striking novelty in the electrical line, or at least the novelties are already familiar to many electricians through having been exhibited at other societies in the course of the past year.

Mr. Duddell's musical arc attracted a considerable amount of attention. As most of our readers are aware, Mr. Duddell obtains musical notes from a direct current arc by placing in shunt with it a suitable self-induction and capacity. Alternating currents are generated in the shunt circuit, which are superimposed on the direct current in the arc. The alternations of temperature thus produced in the arc give rise to sound waves of a pitch corresponding to the frequency of the alternating currents. By means of a keyboard the capacity of the shunt circuit was varied so as to play an octave of the musical scale, then by changing the self-induction another octave could be added. By this means a tune could be played.

Poulsen's telegraphone was exhibited by the Telegraphone Syndicate. The instruments were beautifully made and gave admirable results. A steel wire is wound in spiral grooves on a non-magnetic drum. Close to this wire are the two poles of an electro-magnet connected with a microphone transmitter. Any sounds such as vocal speech or instrumental music actuating the diaphragm of the transmitter, are transferred as magnetic impulses to the electro-magnet, which, when the drum is set in motion, impresses magnetic strains on the steel wire. The electro-magnet, with its two poles facing

the sides of the wire, and guided by a plough running between the spirals, is carried longitudinally along a slide rod until the end of the coiled wire is reached. Thereupon a device shunts the carrier, *i.e.*, the travelling electro-magnet, on to another mechanically-revolving spiral, which quickly takes the carrier back to its original position. The instrument is now ready to reproduce all that the wire has received. The magneto-carrier is connected to an ordinary telephone receiver, and the magnetic strains in the moving wire are reproduced as speech, &c., in the telephone, the latter repeating everything that had been spoken into the microphone transmitter. Mr. Poulsen's telegraphonic distributor is dependent on the same principle for its practical application. A number of electro-magnets take the place of the single (re-transmitting) electro-magnet above mentioned, which, acting as "repeaters," simultaneously signal the message onwards to its several destinations. The telegraphone reproduces music and speech in much greater purity than the phonograph.

Mr. Francis Fox, M.I.C.E., gave an interesting demonstration of the pressures exerted by grain on deep compartments in granaries. It was shown by experiment that the pressure of the grain on the bottom of the compartment was only about one-third of the total weight of the grain, the remaining two-thirds being supported by the sides of the compartment. In connection with the influence of variation of temperature on the permanent way of railways, he showed that the extreme temperatures could not be ascertained by merely placing a thermometer in contact with the rails, but that it was necessary to imbed the bulb of the thermometer in a piece of the rail.

Prof. S. P. Thompson has applied the kinematograph to show the movements of lines of force in a changing magnetic field. The cases illustrated were (1) the magnetic field surrounding an alternating electric current; (2) the attraction by a horse-shoe magnet of its armature; (3) the magnetisation of iron by the current in a solenoid; (4) the "cutting" of magnetic lines by the revolving armature of a dynamo or motor. The diagrams were drawn by hand, and photographed by Mr. R. W. Paul, who lent the kinematograph.

Mr. Mackenzie Davidson showed some stereoscopic transparencies of electric sparks. The small bright spots often seen in photographs of sparks taken by a single lens were clearly shown by these stereoscopic views to be due to the path of the spark being end on at these points. Stereoscopic views of bullet wounds photographed in the South African campaign were somewhat indistinct, but remarkably good considering the circumstances.

Mr. Killingworth Hedges showed specimens of fulgurites, or lightning tubes, consisting of fused tubes of sand, earth, or rocks, which had been found by Mr. Grimshaw at Kensington, N.S.W.

Mr. J. Wimshurst exhibited a number of photographs to illustrate diffusion of the Röntgen rays. These rays appear to be radiated to a certain extent by the air and walls of the room in which an X ray tube is in operation, so that photographs can be taken on plates protected by lead plates from the direct action of the rays.

Callendar and Griffiths's patent temperature indicator was exhibited by the Cambridge Scientific Instrument Company. This instrument, which is very sensitive and has a wide range, consists of a portable d'Arsonval galvanometer, combined with a Wheatstone bridge, and is so arranged that by turning a couple of milled heads the temperature of a platinum thermometer can be read directly in degrees Centigrade. The platinum wire is enclosed in a tube, and being connected by flexible wires to the bridge, can be readily placed in the place, where the temperature is to be measured. The principle of using the platinum wire with a Wheatstone bridge to measure temperature was employed by Leng and Edelmann in 1873 in the instrument generally known as the bolometer.

The stereoscopic range finder exhibited by the Carl Zeiss Optical Works is a very ingenious instrument, and appears to be unsurpassed for rapid range finding. It consists of a stereoscopic telescope with the two object glasses separated by a distance as great as conveniently possible (51 cm., 87 cm. and 144 cm. are the distances in instruments made by the firm). In the focal plane of the object glasses, scales are drawn in such a way that they combine stereoscopically so as to appear like mile posts on the landscape viewed through the telescope. The position of any object can then be readily compared with these standard poles (which are marked with their distance from the observer), and the distance read off without any adjustment.

The tool-grinding appliance exhibited by Mr. C. V. Boys is exceedingly simple and accurate, and ought to be of great value in the workshop. The tool is ground on the side of a carborundum disc, and is supported at the proper angle by placing it on the sloping surface of a table which is slidable parallel to the axis of the grinding disc. The profile angle of the tool is fixed by a fence arranged to slide radially at the required angle on the surface of the table. The tool, with its fence, is transferred to another similar table mounted opposite a finer grinding disc, the table in this case having a slightly less angle. The finishing touch is given to the edge by the finer disc, which is mounted on the same axis as the rough disc.

THE PLAINT OF THE PLANT.

All the machines were doing their work so well, that, to any mere outsider, to whom they would appear nothing more than rather complicated results of man's ingenuity, they would have seemed to be quite contented with their lot; but to me, who had lived with them and tended them so long, they were instinct with living energy, and their language was plain to my ears. Approaching one compact group of workers, and listening intently, I was fain to alter my opinion as to the willingness of this particular set to lighten the darkness of the great city.

The group consisted of three, or "twa and a bittock," for really the third was ridiculously small as compared with the others. Engineers called the group a combined plant—first, the compound vertical engine, which drove the huge machine called the alternator, on a continuation of whose shaft was the smallest of the three—the bittock—called the exciter. Now this last, notwithstanding its insignificance, perhaps trading on it, was the real cause of all the grumbling this evening. If it had allowed the alternator to revolve smoothly, without interfering, perhaps the following conversation would not have been heard, but like most dwarfs, it did all in its power to irritate anything bigger than itself. Two or three minutes after starting up it began passing current through the coils of its companion, knowing that by so doing it would increase immensely the stress on the latter. No doubt it would have been pleased still more if it had known that the engine had as much as it could do to keep up the pace, but, by reason of the interposition of the alternator, this triumph was denied.

Pitifully and continuously the alternator pleads in a thrilling hum to have the load taken off; then, in anger, "Can't you leave me alone for one night, you little vixen; why must you be nagging at me always? Do I ever excite you about anything?"

Now, this was true, for an alternator is a machine that is not built that way.

Answered the exciter: "Often enough have you told me that, and ever have I answered the same. I am driven to it. Here am I fastened to a great lumbering useless thing like you, who ceaselessly whirl me round night after night, till you really make my poles so hot that even the men here notice it, and stroke my cheeks in pity.

"It's enough to make one drown one's cares in oil. For a few moments I bear, and then gradually I feel my temper rising, I watch its growth on the voltmeter; then I hear a man shout 'Any juice?' and another answers 'Yes, she's coming up.' Then I just let myself go, and rip into you to try to stop you. Besides, I don't see why you should not do your share of the work, and you would not do a stroke if I did not excite you to it." Which was true also.

"Well," says the alternator, "if I chose to tumble on you—" "Idle words," spat the exciter, "there would be some difficulty in disintegrating you from the floor. Then, if nothing else will deter you, think of how closely we are connected. Remember the sacred ties of relationship!" Now, as everyone knows, the exciter stretches long tendrils

right into the heart of its mate, and the same currents run through both. The alternator proceeded: "You are also totally wrong in imputing blame and evil motives to me. It is entirely against my will that I do any work at all. No doubt a little exercise is very excellent for the better digestion of the good oil which they give us here, but when they go to the length of making me light up some hundreds of their lamps, I consider they treat me with scant respect.

"Perhaps you don't know that I suffer rather badly from that terrible infliction hysteresis, and the faster I go the worse it is. No! I entirely repudiate any desire to make you work, or, indeed, to work myself. All the blame for this unnecessarily fast life I throw on this oil-spattering, angular, top-heavy conglomeration of cast-iron, steel and brass to which I am, unfortunately, attached, not by any lasting friendship—though we grew up together—but by a mere flexible coupling. I exert all my inertia to stop him from beginning, but, with a few grunts and hisses, covering me with a cloud of steam, he begins unceremoniously to turn me round. Then you begin shoving your currents angrily through me, and I double my retarding efforts; but, although the engine has to work immensely hard, and strains all his parts with his hateful endeavours, he still keeps up the same dizzy pace. People talk of a revolution being the only means by which to gain their rights! Why, I make some 200 every minute, and where am I at the end of each?

"I have tried even the desperate expedient of 'shuffling off these mortal coils,' but they are so well fastened on that it is almost impossible to stir them." "Do stow that everlasting buzz," broke in the engine. "Here am I, ready to burst my cylinders with rage and compressed steam, at having to bustle round at this enormous speed. Talk about heat! I should just like you to put one of your coils in my high-pressure cylinder, or the low-pressure, for the matter of that. I guess you'd think you had been living in the arctic regions till then. *You* grumble about your hardships and trials, indeed! Before I came here they gave me a six-hours' trial, and found nothing against me; then, instead of leaving me alone, they plant me here and make me go through something worse than an execution every night. Think of my constitution. The House of Commons is burdened with a good gathering of faddists, but I have to carry round two cranks and a couple of eccentrics all the time, and, as in the House, they make all the row (till they are taken up). I used to think that all my troubles were caused by that uncomfortably hot body, steam, but he says he can't help it; he is forced to come along and poke himself into my internals. Steam assures me that the root of the whole evil is spite on the part of the coals, whoever they are. They seem to have been buried for some hundreds of centuries, and in order to celebrate their release, they get red hot, and make themselves generally unpleasant.

"Please don't curse me any more. My lot is harder than yours, and as for steam, I do my best to cool him, although he is rather unpleasant in here in the form of water, my only tipple being best cylinder oil."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

8,744. "Improvements in methods or means of insulating electric wires." B. G. Hodges. April 29th.

8,803. "Improvements in safety devices for electrical measuring instruments." V. A. Arconi. April 29th. (Complete.)

8,806. "Improvements in switches for the trolley lines of electric tramways." C. Dalmas. April 29th.

8,831. "Improvements in party line system telephony." W. Garner. April 30th.

8,833. "Improvements in interrupters of induction coils." D. F. D. Turner. April 30th.

8,889. "Improvements in or relating to electric signals." J. Netter and H. Queyroul. April 30th.

8,890. "Improvements relating to printing electric telegraphs." J. E. Heimerdinger. April 30th. (Complete.)

8,892. "Improvements in electric clocks and time pieces." R. M. Lowne. April 30th.

8,906. "Improvements relating to the transmission of electric currents." L. Maiche. April 30th.

8,920. "Improvements in electric switches." J. E. Spagnoletti. April 30th. (Complete.)

8,922. "Improvements in or relating to telephone systems." O. Angelini and A. Jengo. (Date applied for under Patents, &c., Act, 1883, Sec. 103, October 20th, 1900, being date of application in Italy.) April 30th. (Complete.)

8,932. "Improvements in primary electric batteries." F. M. Chaplet. April 30th.

8,946. "Improvements in electrically-driven centrifugal machines." J. B. Alliott and J. McC. C. Paton. April 30th.

8,943. "Improvements in apparatus for measuring the magnetic properties of materials." F. G. Baily. May 1st.

8,953. "Improvements in main switches specially applicable for high tension circuits." J. Hamer. May 1st.

8,856. "Improvements in the construction of dynamo-electric machines and electro-motors." E. S. G. Rees. May 1st.

8,957. "An improved shade carrier for electric light fitting." J. A Morton. May 1st.

8,962. "Improvements in switch apparatus for use in a surface contact system of electric traction, and in operating switches used in such system." T. H. Parker. May 1st. (Complete.)

8,964. "Improved means for use in operating from a car or train switches employed with a surface contact system of electric traction." T. H. Parker. May 1st. (Complete.)

8,965. "Improvements in or in and relating to skates or contact makers carried by cars for use in a surface contact system of electric traction." T. H. Parker. May 1st. (Complete.)

8,966. "Improvements in switches." C. Schinzer and N. J. Goldfarb. May 1st. (Complete.)

8,967. "Improvements in the method of forming armature coils for dynamos and electric motors and in apparatus for use therein." T. H. Parker. May 1st. (Complete.)

8,997. "Improvements in apparatus for governing electric currents." A. W. Gattie. May 1st.

8,998. "Improvements relating to X-ray tubes." A. C. Cossor and W. U. Hilliar. May 1st.

9,002. "Improved high tension switch." W. P. Thompson. (The firm of Voigt & Haeffner Actien Gesellschaft, Germany.) May 1st.

9,011. "Improvements in the electro-deposition of metals for the manufacture of compound wire bars and the like and in apparatus therefor." R. D. Sanders. May 1st.

9,019. "Improvements in electric gear for controlling lifts or hoists." J. Bjornstad. May 1st.

9,023. "Improved means for testing secondary batteries." L. Bristol. May 1st.

9,038. "Improvements in life guards for electric tramcars or similar vehicles." F. Lamb. May 2nd.

9,056. "Improvements in apparatus for treating telegraph or telephone cotton-covered cables or wires." E. A. Claremont and C. J. Beaver. May 2nd. (Complete.)

9,076. "Improvements in or relating to mercury or mechanical interrupter for induction coils in connection with X ray work." H. W. C. Cox. May 2nd.

9,079. "An improved method for the protection of overhead systems of transmission of electric currents." C. J. R. le Mesurier. May 2nd.

9,080. "Improvement in the controlling of the working of railway signals and points by electricity." I. A. Timmis. May 2nd.

9,087. "Treatment of magnesite for the manufacture of refractory articles and structures." W. S. Rawson and R. D. Littlefield. May 2nd.

9,097. "Means for electrically controlling and igniting and extinguishing gas from a distance." H. Borchardt. May 2nd. (Complete.)

9,123. "Improvements in or relating to means for utilising magnetic force for motive power, also applicable for insulating purposes generally." J. Chandler. May 2nd.

9,157. "Improvements in switches for use with alternating current dynamos." The Electric Construction Company, Limited. (J. Roberts, South Africa.) May 2nd.

9,147. "A life-guard for electric cars, railway locomotive engines, motor cars, and all steam machines on the public road." G. Kirby. May 3rd. (Complete.)

9,154. "Improvements in or relating to telegraph, telephone, overhead tramway and like wires." G. E. Heyl-Dia. May 3rd.

9,187. "Improvements in electrical accumulators." C. P. Elieson and V. De Bobinsky. May 3rd.

9,188. "Improvements relating to induction coils." Sir C. S. Forbes, Bart. May 3rd.

9,193. "Improvements in gear for actuating the electric switches of cranes, capstans, and the like." Sir W. G. Armstrong, Whitworth & Co., Limited, and J. Honner. May 3rd.

9,203. "Improvements in and connected with current collecting devices for electric railways, tramways, and the like." W. Behrens and J. P. Tihon. May 3rd.

9,211. "Improvements relating to the insulation of electrical conductors and the like, and to compounds therefor." H. H. Lake. (O. T. Hungerford, United States.) May 3rd. (Complete.)

9,212. "Improvements in the method for protecting underground electric mains and for like purposes." F. Irvine. May 3rd.

9,213. "A new or improved galvanic cell." G. B. Puchmuller. May 3rd.

9,217. "Improvements in electric fuses or cut-outs." J. Y. Johnson. (The D. and W. Fuse Company, United States.) May 3rd. (Complete.)

9,227. "Improvements in contacts and spring actions for electric switches." W. C. Westwood and A. Hitchen. May 4th.

9,275. "Electric arc lamps." T. W. Young. May 4th. (Complete.)

9,276. "Improvements in electric time checking and time recording apparatus." C. Miles. May 4th.

9,275. "Improvements in and connected with means of supplying current to electrically-propelled vehicles from an overhead conductor." J. T. Armstrong and A. Orling. May 4th.

9,276. "An improved electric heating body." I. Timar. May 4th. (Complete.)

9,279. "Improvements in and connected with the trolley poles of electric cars and the like." P. McCullough, T. Blaney, and R. Baron. May 4th.

9,284. "Improvements in electrical instruments for signalling on railways." E. Tyer, F. T. Hollins, and F. W. Leake. May 4th.

9,295. "Improvements in means for preventing the oscillation of alternators connected in parallel." R. Haddan. (O. T. Blathy, Hungary.) May 4th. (Complete.)

9,302. "Improvements in electrical transformers." A. F. Berry and The British Electric Transformer Manufacturing Company, Limited. May 4th.

9,303. "Improvements in electrical transformers." G. Berry. May 4th.

9,307. "Improvements in circuit arrangements for inter-communication telephone or telegraph systems and other electric signals, and switches for same." A. C. Brown and J. H. Hawksworth. May 4th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

14,501. "An electrical accumulator." R. Hills. Dated July 14th, 1899. The negative plate consists of a thin plate of aluminium, and the electrolyte is an aqueous solution of zinc sulphate. The positive plate is an ordinary perforated lead plate pasted with red lead and litharge. 1 claim.

14,265. "An automatic signalling apparatus for electric tramways." C. Wehner and H. Laube. Dated July 11th, 1899. Relates to signalling apparatus for use at curves, crossings, &c., on electric tramways. On each side of the curve, &c., an insulated contact-plate is mounted on the line-wire, so as to be connected with the line-wire by the trolley of the car. The first contact is connected by the lead with the solenoid of the signalling apparatus, and the second contact is connected by the lead with an electro-magnet adapted to disengage the catch, both circuits having an earth connection. The core of the solenoid has a spiral thread, and carries a signal-disc mounted in front of a box containing a number of coloured lamps which are connected to the line-wire by the lead. In the normal position the disc is parallel with the rails, and the lamp-box and the earth connection of the lamps is broken between the contacts. When a car passes the first contact, the solenoid is energised and raises its core, so rotating the disc into a position, where it is locked by the spring catch engaging the arm on the disc. In this position, the disc also brings the contacts together so that the lamps are lighted. When the car passes the second contact the catch is withdrawn, the disc returns to its normal position, and the lamp circuit is broken. The disc, &c., may be replaced by an arrangement of red and green lights. 1 claim.

14,408. "Improvements in submarine cables." G. G. M. Hardingham. (Felton and Guilleaume.) Dated July 12th, 1899. Submarine cables have their self-induction increased by employing round a central core a ring of shaped, or shaped and circular conductors of dissimilar metals, such as iron and copper, or the ring may be of iron and the core of copper. The whole is enclosed in an insulating covering. 3 claims.

14,449. "Improvements in wireless telegraphy." S. G. Brown. Dated July 13th, 1899. Relates to systems of wireless telegraphy, in which the transmitters and receivers are provided with aerial or earth conductors separated by half or one and a half wave lengths. The conductors are arranged in a plane, and many have parabolic reflectors of reticulated metalwork; the reflector may be insulated and form one of the radiating-surfaces, or may be earthed without being employed as a radiator. Two transmitting radiating rods are connected to the spark gap and to a high potential condenser through inductances. The receiving rods are connected to the coherer, and through two inductances to the local circuit. The radiator rods may be looped together, or, according to the provisional specification, a number of such rods may be employed connected to separate induction coils and coherers. 8 claims.

14,467. "Improvements in and relating to electric traction with overhead conductors." T. Pease and C. B. Burdon. Dated July 13th, 1899. Relates to overhead conductor systems of electric traction for tramcars, road vehicles, canal boats, &c. The current is supplied by a trolley running on the overhead conductors and connected to a mast on the vehicle, &c., by a flexible connection. The conductors, of which there may be two or more for single or polyphase currents, are supported in brackets on posts. The trolley is hung below the wires, and has two or more wheels running on them, and when a third wire is used, a third collecting wheel may be mounted on the trolley like the collector in ordinary overhead electric tramways. Brakes bearing on the wheel maintain tension in the cord, or a motor may be mounted on the trolley to propel it, and also transformers to transform the current before it goes to the vehicle motors. 1 claim.

14,489. "Improvements in coin controlled call-recording device for telephone systems." J. B. Gill. Dated July 13th, 1899. Telephonic apparatus; registers.—After prepayment, an electro-magnet operates its bell-crank armature so as to disengage a bell-crank rack from a lug on a slide resting on a bed. The slide is consequently moved so as to force a needle, which it bears through a card clamped upon a disc. Owing to guidance by an oblique slot engaging a fixed pin, the slide swivels to a slight extent, so that the needle turns the card and disc through a small angle. The slide is reset by pressing a button acting on a bell-crank, but the card and disc are not reversed, because of the increased friction of the disc against the bar which bears it. The succession of punctures in the card occurs spirally, because the spindle of the disc travels in a vertical slot in the frame bar as a spiral groove on the disc passes over a lug on the bar. Coin action.—The coin dropped into a shoot presses against an incline on an electric terminal, which is jointed to the bell-crank armature. This terminal is consequently displaced into contact with a strip terminal. A coin too light to be effective itself is thrust on the incline by a bell-crank, which is actuated from another bell-crank under the push-button through the medium of a vertical rod. Coin-discharging mechanism.—The coin is prevented from shooting past the incline by a pellet, but the movement of the attracted armature swings the terminal away from the shoot. Fraud preventing.—To ensure the coin being deposited in the box and the push button being released before the record is made on the card, a cut-off working across the coin passage is connected with the push button so as to drawn back clear of the passage when the button is pressed. The vertical thrust-rod detaches the armature from the coils if retained by residual magnetism. The coin shoot curves to a side pocket, where the coin may be inspected till the push button is operated again, and a trap is drawn aside to let the coin drop into the receptacle. Wrong coins can be let out of the shoot at the bend through an aperture with a flap controlled by a separate push piece. 23 claims.

14,568. "Improvements in electrical alarm apparatus." C. Eggerding. Dated July 14th, 1899. Electric bells; bells, silencing; indicating ringing of bells to operators.—Relates to call bells such as are used for waking servants, &c. The bell is operated when its circuit, which includes a battery, is closed by raising the drop-down armature until it makes contact with the core of the electro-magnet. This contact is maintained by the electro-magnet, the circuit of which is continued through the contact as the hammer armature approaches the bell magnet, so that the bell continues to ring until the person awakened breaks the circuit by means of a push, or until the operator pulls the armature away from the core. In an alternative arrangement, the circuit of the electro-magnet is maintained through a suitable resistance, arranged in a shunt from the bell circuit. The variations in the current through the electro-magnet acting through the core produce a vibration of the armature which indicates the operation of the apparatus to the operator. 2 claims.

14,569. "Improvements in dynamos." W. B. Sayers. Dated July 14th, 1899. Sparking, preventing; dynamos, regulating. In order to enable the brushes of a dynamo having an ordinary drum or ring armature to be maintained in a fixed position without sparking, notwithstanding variations of load, and to obtain an improved regulation of the machine, the trailing or rear end of each field-magnet pole is provided with an inwardly-extending polar extension between which and the main pole is formed a cavity or recess. The brushes are of carbon, and are so arranged that each section of the armature winding will be short-circuited, as it is passing the polar extensions, and that the forward of the two commutator sections to which the commutated armature section is connected will pass out of contact with the brush as the said armature section is brought opposite the cavity or recess. 2 claims.

14,572. "Improved system of electro-dynamo propulsion." (L. Rosenfeld.) Dated July 14th, 1899. Relates to that system of electric propulsion by means of polyphase currents in which the two elements of an induction motor are extended into a straight line so that a rectilinearly-moving magnetic field is developed, the inducing element being laid on the track, and the induced element being carried by the vehicle. The two elements of the motor, each consist of a laminated iron body provided with pole-pieces and wound with conductors after the manner of a drum or ring armature. To permit of the air space between the fixed and moving parts being increased without increasing the weight of copper, the pole-pieces are formed with lateral extensions. The longitudinal parts are fitted into braces, and the lateral extensions are supported by adjustable tie-rods. The pole-pieces may be built up of T-shaped plates, or of two sets of rectangular plates of different lengths bent at right-angles. To control the speed of the vehicle, the induced winding may be connected to a rheostat as in the case of ordinary induction motors. The widened pole-pieces above described, may be employed in alternating-current motors generally. 4 claims.

14,632. "Improvements in collectors for electrically-propelled vehicles." F. Chone. Dated July 15th, 1899. Electric railways and tramways with overhead conductors. Collectors. The trolleys of vehicles running in opposite directions work on a single wire, and are arranged to pass each other. For this purpose the wheels may be flanged and grooved or made of different breadths and diameters, or one wheel may be furnished with a guard under which the other runs, while the ends of the poles which carry the wheels are bent in opposite directions to reach the centrally-placed wire. 2 claims.

14,687. "Improvements in electric magnetic brakes for railway and tramway cars." P. F. L. R. H. K. Voegt and W. C. Kusterer. Dated July 17th, 1899. Brakes, electric and magnetic. On closing the circuit through the coils of the electro-magnet the plate is attracted and is then reciprocated by a "make-and-break" arrangement. A spring pawl carried by a plate rotates a ratchet wheel, and by spur gearing draws up a rack, and rods apply the blocks to the wheels. When the coils of the electro-magnets are excited, a plate loose on the shaft is attracted, and its pins are drawn out of holes in the ratchet wheel and disc, loose and fast, respectively, on the shaft. The rack now drops by its own weight, and the brakes are retracted. 1 claim.

14,703. "Improvements relating to carbon electrodes for electric arc lamps." H. Bremer. Dated July 17th, 1899. Arc lamps. Electrodes are made of carbon uniformly mixed with luminiferous matter, such as alkaline earths, or calcium carbonate, fluoride, or silicate, or increase the production of light, and are coated with material adapted to form a fused slag therewith, this dropping off near the arc. The coating also protects the carbons from the air. Suitable coatings are produced by electroplating with metal, or by dipping red-hot carbons in fused boric acid, borax, or a neutra or acid borate or alkaline silicate; metal coatings are used only on carbons containing at least 5 per cent. of mineral matter. 3 claims.

14,704. "Improvements in electrodes for electric arc lamps." H. Bremer. Dated July 17th, 1899. Arc lamps.—Electrodes are made of carbon mixed with large proportions of salts of calcium, magnesium, strontium, or other metals to increase the production of light, and such that the electrodes contain at least 5 per cent. of fluorine, iodine, or bromine to form fusible slags with the bases, which fall off in small drops near the arc. Calcium fluoride and cryolite are most suitable; an electrode may contain 10 to 60 per cent. of the former. To prevent flickering, the electrode should also contain 1 to 10 per cent. of a salt of boron, potassium, or sodium, such as boric acid, borax, or potassium or sodium carbonate or silicate. The salts should be calcined previously to remove water of crystallisation. The lower electrode of a pair should be provided with a glassy coating of borax, a silicate, or other suitable material, on which drops falling from the upper electrode run away from the arc. The upper electrode may be coated similarly, or with metal, to protect it from the air. The provisional specification mentions the use of pulverised metals or oxides in the electrodes. 5 claims.

14,736. "An improved winding for dynamos." M. H. Hurrell. Dated July 18th, 1899. Field magnets.—Series compensating coils, preferably on magnetic coils, are provided between like poles or in a multipolar generator or motor, to prevent inequality in the field below the leading and trailing parts of each pole-piece, weakening of field, and sparking. The application of the invention to a magnet having three like poles extending inward from one end of the armature opening, and three opposite poles extending inwards from the other end connected by oblique cores is shown. It is applicable similarly to a hollow cylindrical magnet covering a single concentric exciting coil, which may be wound on the armature core, and to other forms of field magnet. Application to self-propelled vehicles is mentioned, an external armature being carried by end discs rotating on a stationary shaft, which supports an internal magnet. The armature is attached to a road wheel. The provisional specification states that the compensating coils may be wound partly on the magnet cores. 3 claims.

14,806. "Improved counter or meter for electric lamps, motors, and other electric apparatus." G. de Paolo Magini. Dated July 18th, 1899. Relates to quantity meters. The duration of a supply of current to an arc or incandescent lamp, motor, or other apparatus is registered by the apparatus described. The current is supplied through the coils of electro-magnets if in excess of allowed strength, the first magnet moves a weighted lever, which opens the circuit. The proper current causes the first magnet to move a lever and clutch to connect a shaft with a loose pinion, which is geared to number-wheels. The second magnet turns a weighted stop to start the balance-wheel of a clock-work, driving the shaft and clutch. The number-wheels are thus driven by the clock-work so long as sufficient current passes through the first coil. The shaft may similarly drive any number of counters under control of additional electro-magnets, each in circuit with one lamp, &c., and a switch, but all in circuit with the starting magnet. In running down, the clockwork causes a crank disc to make one turn, the crank finally shifts a cut-out lever to open the circuit unless the clockwork is rewound. The winding key is loose, but has a conical projection to prevent its removal from the case, and to hold the cut-out lever so that current cannot be used while the key is on the winding stem. The key also gears with and returns the crank disc. 6 claims.

14,878. "Improvements in covering electrical and other wires and in apparatus therefor." W. W Colley. Dated July 19th, 1899. Electric conductors are covered with a strip of paper applied in one or more spirals, each spiral consisting of several layers of paper, such as asbestos and other paper of tough nature. Comprises a rotating frame through which the wire to be covered passes, spools of multiple paper strip, and laying-on guides. The take-up is driven by gearing from the frame spindle, a clutch being employed for throwing the whole into or out of gear. The provisional specification described a form of machine in which the wire passes through the spools, the multiple spools being prepared on the machine. 4 claims.

14,906. "Improvements in fuse blocks for electric circuits." H. P. Davis. Dated July 19th, 1899. (Date under International Convention, January 30th, 1899.) Fuses adapted for heavy currents are provided with a strong casing and with means for protecting the terminals. The fuse-holder may be made of layers of paper bound with steel wire, and is fitted with end plates connected by insulated bolts. It is suitably connected by a clamp to the base and is fitted with an escape tube for gases. The body is fitted with metallic end pieces screwing into the terminals of the conductors. The fuse is provided at each end with terminals perforated at one end to receive the fuse, and at the other made in the form of a split tube to fit in the ends. The inner end of the terminal carries a tube of paper, partly filled with asbestos or like incombustible material, over which is placed a follower. When the fuse blows, the pressure of the gas forces in the follower, compressing the asbestos over the terminals and so protecting them. 4 claims.

14,907. "Improvements in electric circuit breakers." H. P. Davis and G. Wright. Dated July 19th, 1899. (Date under International Convention, March 23rd, 1899.) Relates to an overload magnetic cut-out having auxiliary infusible contacts adapted to rub on making and braking. The fixed contacts are carried on an arm fixed to the base. The movable contacts are carried on a pivoted arm in a triangular frame. Electrical connection is made through a flexible conductor. The triangular frame is fixed on a sleeve to which is also fixed a projecting piece. A spring connects this piece with the base, and another spring with the pivoted arm. The frame is also connected by toggle-levers with an arm engaging with the trip mechanism of an electro-magnet. When the arm is released the spring connecting the projecting piece with the base lifts the projecting piece, and finally throws over the arm. The cut-out is re-set by the handle, the inner end of which engages with the projecting piece, and forces it into position. 3 claims.

14,897. "Improvements in switches for electric circuits." G. Wright and C. Aalborg. Dated July 20th, 1899. (Date under International Convention, January 30th, 1899.) Relates to a switch which cannot be described without reference to a drawing. 3 claims.